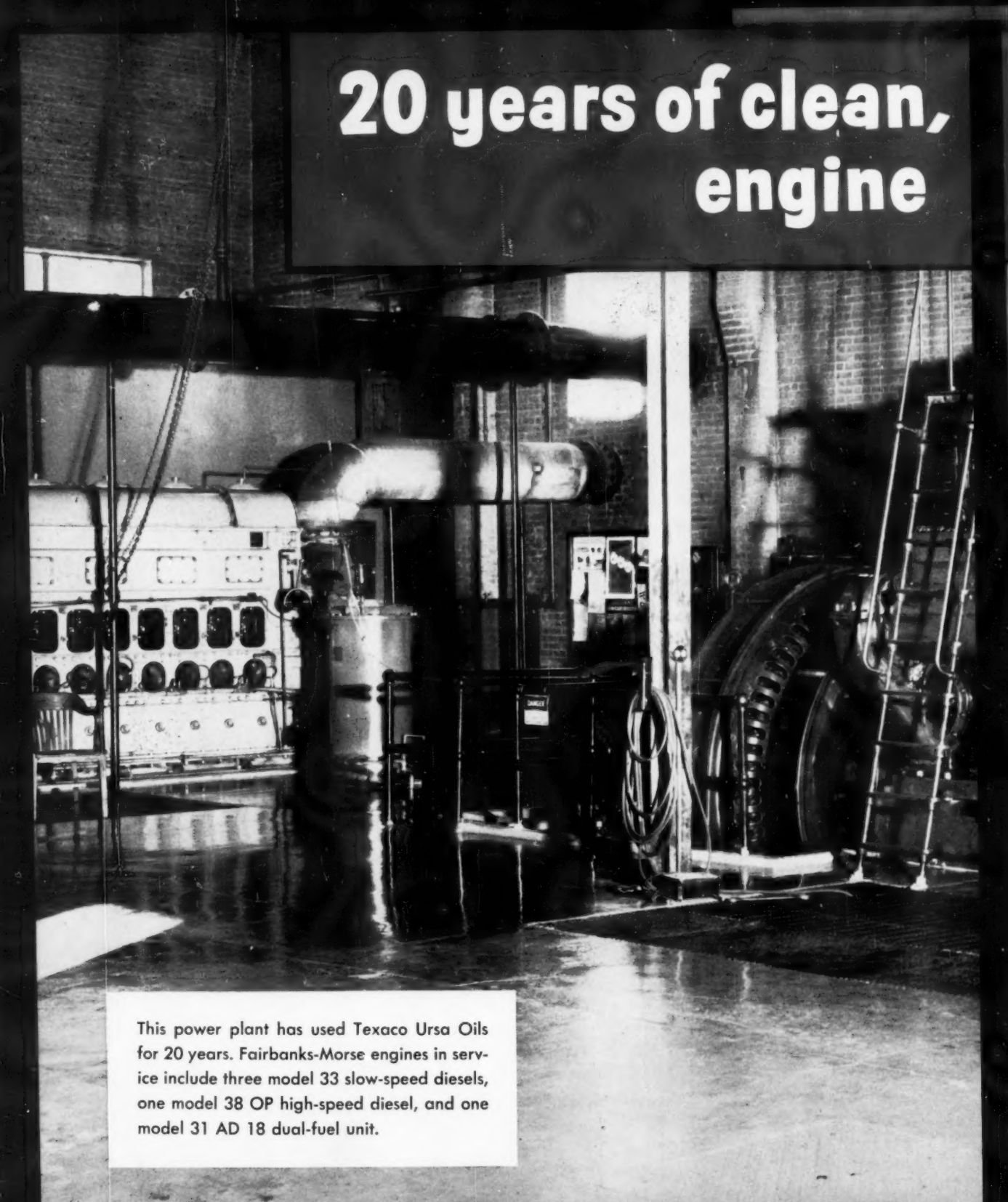
diesel power

September 1955
PART I

Filter change practices

20 years of clean, engine



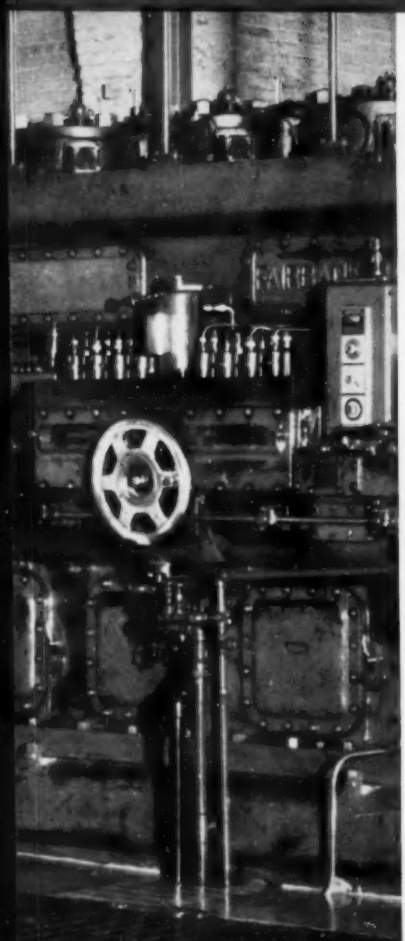
This power plant has used Texaco Ursa Oils for 20 years. Fairbanks-Morse engines in service include three model 33 slow-speed diesels, one model 38 OP high-speed diesel, and one model 31 AD 18 dual-fuel unit.

TUNE IN:
TEXACO STAR THEATER
starring
JIMMY DURANTE
on television...
Saturday nights, NBC.

TEXACO

TEXACO

economical performance



THIS plant (name on request) operates both straight diesel and dual-fuel engines — all of them lubricated with *Texaco Ursa Oil*. The Plant Superintendent says:

> **"Never, in more than 20 years, has Texaco Ursa Oil 'let us down.' Our engines stay clean; wear is negligible, and we enjoy real fuel economy."**

This experience is typical. *Texaco Ursa Oil* does a great job of keeping engines clean. It stands up under heat and pressure . . . stands off oxidation and sludging . . . keeps rings free for proper compression and combustion. This means you'll use less fuel . . . spend less for maintenance.

There is a complete line of *Texaco Ursa Oils* to give your diesel, gas or dual-fuel engines the best "run" for your money. Leading engine builders O.K. them; operators everywhere use them. In fact —

> **For over 20 years, more stationary diesel h.p. in the U.S. has been lubricated with Texaco than with any other brand.**

Get the full story from your Texaco Lubrication Engineer. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

A set of Monmouth* Clevite* 77 bearings will cut your down-time

● It's the down-time that gets you!

Every fleet or commercial operator will agree on that! So what's to do about it?

One thing that plenty of operators do is to standardize on Monmouth Clevite 77 high-duty bearings. These bearings are identical with those originally installed in leading makes of heavy-duty engines and are giving better than 250,000 miles of service with little sign of wear on either shafts or bearings.

Because these bearings are identical with the original, they fit better and are easier to install.

Because they last longer, they not only cut down-time but they also save on operating costs. And they can withstand the abuse of long, sustained runs at higher speeds and with bigger loads.

Next time you tear down an engine, try a set of Clevite 77 bearings. You can get them from your nearby N.A.P.A. jobber.

*The words Monmouth, Clevite and Micro are registered trade marks of Clevite Corporation.

Monmouth

TRADE MARK

ENGINE BEARINGS

Clevite Service
The Cleveland Graphite Bronze Co.
Division of Clevite Corporation, Cleveland, Ohio, U. S. A.

NAPA
Assurance of Quality

Your NAPA Jobber is a Good Man to Know!

Nordberg Diesel Completes Almost 4 Years of Round-the-Clock Operation at Hudson, Mass.—On the line 91% of this time

City Now Orders Larger Nordberg Engine Rated 5100 bhp.

HUDSON, MASS. Since going on the line at this modern, efficient municipal light and power plant almost four years ago, a 4250 bhp. Nordberg Diesel engine has been operating 91 per cent of the time, working a "round-the-clock" schedule 7 days a week. Throughout this period the "work-horse" engine has never had a forced shutdown due to engine failure, is the most efficient unit in the entire 7-engine plant and is guaranteeing a source of continuous, dependa[ble] power at low cost for the surro[unding] communi[ty]

The a[rrangement] of the 3300 kv[a] berg h[as] Con[tract] or[der]

her oblig[ation]
Repr[esentative]
mission[er]
commi[ssioner]
Mari[ne]
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● From the day this big 10-cylinder 4250 bhp. Nordberg 2-cycle Diesel went on the line, it has been the Hudson plant's base load unit, generating an average of 75 per cent of the plant's total production. *It is almost never idle, operating around the clock, Sundays and holidays included, and is shut down only a few times a year for inspection and preventive maintenance.*

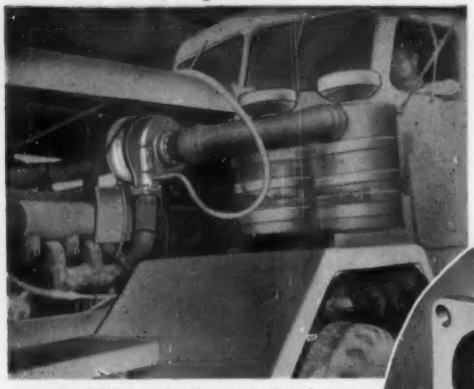
With this outstanding record of reliability, plus extremely low operating and maintenance cost, it naturally followed that when this plant needed additional capacity, they again chose Nordberg. A second large Nordberg Diesel will be installed in the Hudson, Mass. plant in the summer of 1955. This 2-cycle unit, rated 5100 bhp., will operate at 240 rpm., 75 BMEP.

Here again is further proof of the kind of dependable performance that users have learned to expect from Nordberg Engines . . . in sizes from 10 to over 10,000 hp.

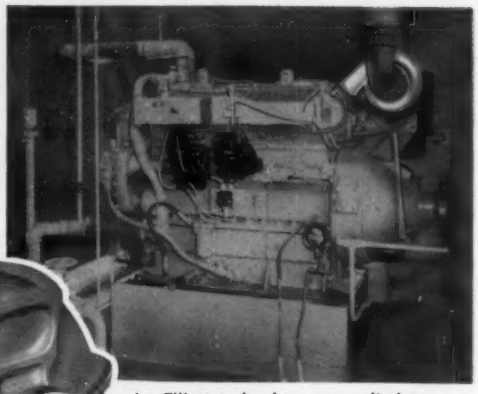
NORDBERG MFG. CO., Milwaukee, Wis.

© 1955, Nordberg Mfg. Co. P155

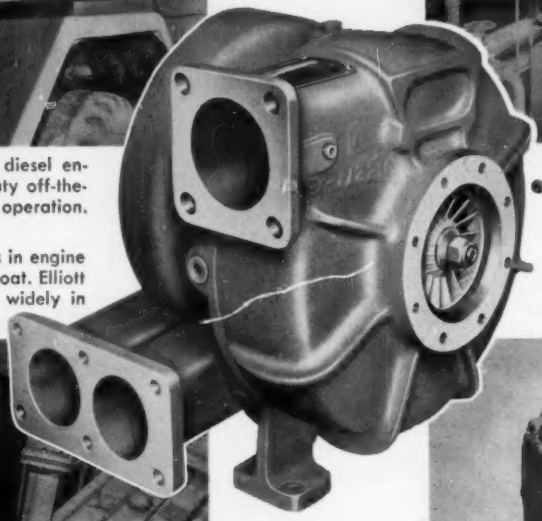
You can count on ELLIOTT turbocharging!



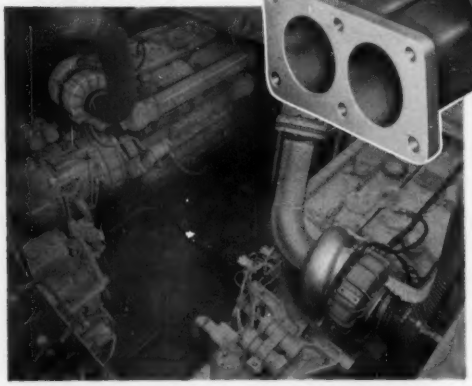
An Elliott turbocharged diesel engine used in a heavy-duty off-the-highway truck in a mining operation.



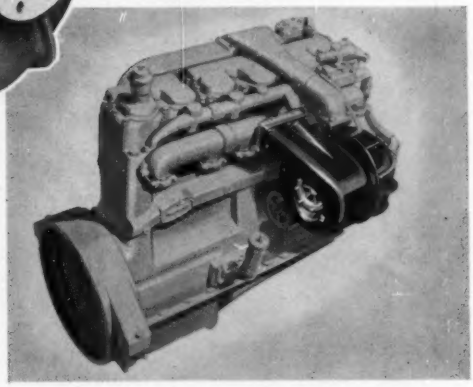
An Elliott turbocharger applied to a diesel engine in an industrial pumping installation.



Two Elliott turbochargers in engine room of a powerful towboat. Elliott turbochargers are used widely in marine service.



Elliott turbochargers also boost output of high-speed engines like this for truck, marine, locomotive and stationary plants.

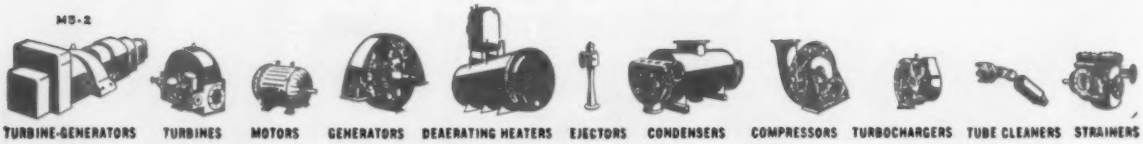


Back of today's Elliott turbochargers...

. . . are 15 years of design, manufacturing and application experience with over 12,000,000 hp of turbocharged engines! These turbochargers are piling up thousands of operating hours on the toughest kinds of service—on heavy-duty on-and-off-highway trucks, railroad locomotives, oil-well drilling rigs, drag lines, power shovels, marine and stationary installations. When your diesel engine is equipped with an Elliott turbocharger you can count on it to deliver the trouble-free performance and high operating standards required.

Get full information on Elliott exhaust-driven turbochargers for four-cycle or two-cycle engines. Specify them on your next engine, whatever the application. Elliott Company, Supercharger Dept., Jeannette, Pa.

ELLIOTT Company



editors notes...

You'll want to read about...

An installation designed to use any of three fuels as needed to get the greatest overall operating economy. Also, special governing problems are being solved by the use of an electrical governor of new design. . . .

How carefully planned operation at all levels, rugged and well-maintained equipment, and organizational teamwork is paying off in a large trucking fleet. Principles and procedures applied could well serve as a guide for other types of operation as well. . . .

How four standardized turbocharger models with overlapping performance ranges promise less costly turbocharging over a broad engine horsepower range. . . .

A high-power mobile gas turbine-generator unit designed as an emergency and disaster power plant for civilian and military use. . . .

Developments in the railroad field aimed at the reduction of passenger carrying costs by the use of lightweight high-speed trains and locomotives of advance design. Looks as though both operationally and cost-wise, passenger carrying is in for great improvement. . . .

A survey of lube and filter change practices in some small trucking fleets. You'll want to read this article to see what's going on. Perhaps you're faced with some similar problems, in which case you'll want to follow up in future issues, when we give you some of the answers. . . .

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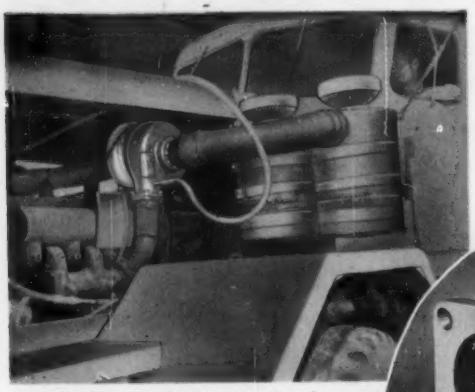
You can count on ELLIOTT tu



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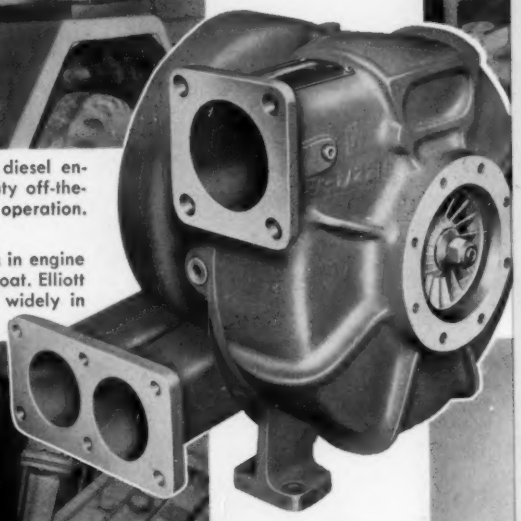

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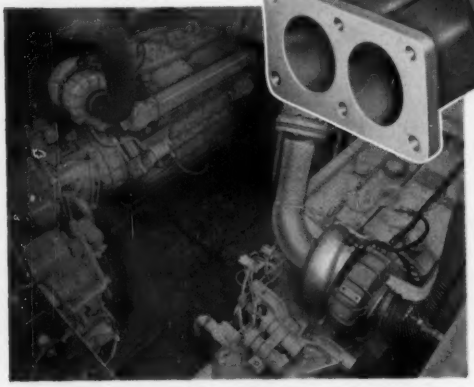

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ELLIO

You'll want to read about...

The report and recommendations of a DEMA committee formed to study the problem of burning residual fuel oils. . . .

How you can use your standard power tools right on the job. The engine in your service truck powers a 10-kw alternator small enough to go under the hood. . . .

The control setup for unattended operation of that symbol of dependability, a lighthouse, using diesel engines for power. Details of these controls may give you ideas for your own automatic control problems. . . .

Licking fastening problems in light alloy parts and components. One beauty of the insert treatment is that it applies both to new components and can be field-applied to restore threads to standard. . . .

A group of additives that have been pelletized to simplify storage, handling, and application. Making these jobs simpler is one way to encourage consistency of engine protection. . . .

Next month we devote the entire issue to tooling and maintenance. We have done this each October for a number of years. During this period, service information has loosened up more and more with the result that soon all the issues will have a higher percentage of shop material. We'll keep plugging; you keep reading. . . .

And don't miss our regular features.

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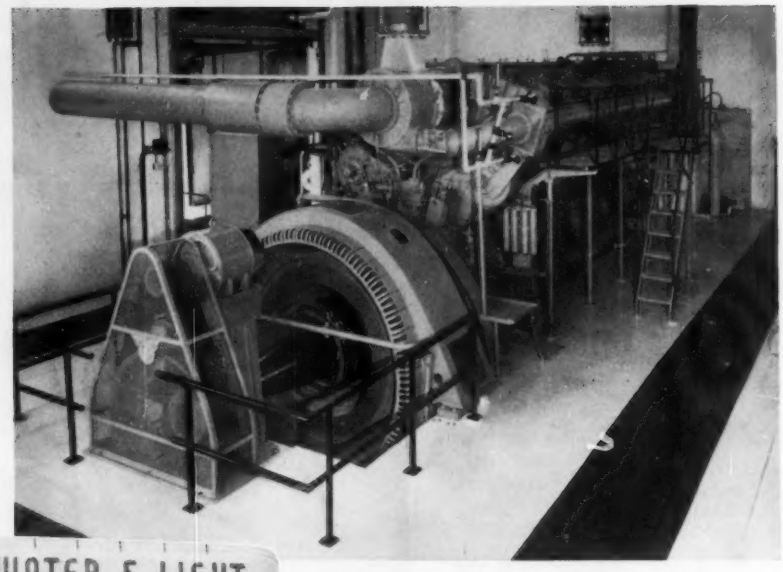
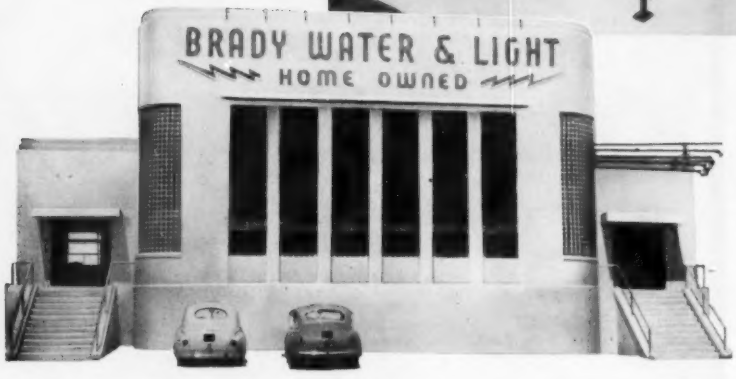
Another Example of Efficient Power at Lower Cost





Above Latest addition to the Brady, Texas, plant — a 3,550 hp supercharged Cooper-Bessemer LSV-16 Gas-Diesel installed in August 1952

BRADY'S GREATEST PUBLIC BENEFACTOR

. . . a Cooper-Bessemer-powered municipal plant

TO say that the home-owned water and light plant at Brady, Texas, is a public benefactor is putting it mildly! Since 1942 this plant has advanced to this city of 7,000 more than $600,000 for civic improvements, *plus* service donations exceeding $200,000. It has helped keep taxes very low while defraying the costs of fire fighting equipment, police protection, street lighting, a new "whiteway" system, power for churches and schools at half cost, road improvements, 20 miles of new pavement and various recreation facilities including a swimming pool.

The Brady plant, like so many other efficient municipal plants, is powered with modern Cooper-Bessemer Gas-Diesels, assuring the highest thermal efficiencies known. Brady's latest is a big 3,550 hp supercharged unit installed in August last year. Because of its high efficiency it is kept in virtually 24-hour operation . . . 5205 hours through March 20, producing 7,325,000 kwh. The remainder of Brady's power is supplied by two older tandem-connected Cooper-Bessemers almost as efficient.

To make the most of your power plans for the future, be sure to check on the distinct advantages you stand to gain with modern Cooper-Bessemers.

MOUNT VERNON, OHIO
COOPER-BESSEMER
GROVE CITY, PENNA.

New York Washington, D.C Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Shreveport St Louis Los Angeles Chicago Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Tulsa Gloucester, Mass. New Orleans, La.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS • HIGH PRESSURE LIQUID PUMPS

Calumet Division, Calumet and Hecla, Inc., Calumet, Michigan

"Cities Service Heat Prover Played A Major Role In Our Expansion Program"

Miners and refiners of copper, the Calumet, Michigan Division of Calumet and Hecla, Inc., relies on two power plants to operate its many mines, reclamation plants, mills, manufacturing facilities and mine rehabilitation projects.

The two plants, located at Lake Linden and Hubbell, were recently brought up to date. The Lake Linden plant now has modern steam generating equipment fired with pulverized coal. The Ahmeek plant was equipped with new coal distributors for its underfeed stokers and new plastic monolithic furnace settings.

This modernization program, along with a planned preventive maintenance program which is now being put into effect, is expected to raise the KW capacity of these plants from 20 megawatts to 30 within the next few months.

The Cities Service Heat Prover has played a major role in this improvement program. It is used extensively to examine combustion conditions in the furnaces, check station instruments, and guard against air infiltration through boiler settings and duct work, thus enabling plant personnel to operate the equipment constantly at design efficiencies or better.

Says Power Superintendent, Robert Hein: "The portable Cities Service Heat Prover has proved invaluable in our operation. We are now using 150,000 tons of coal per year and operating at boiler efficiencies around 86%. By giving us a quick, accurate check on our firing conditions, the Heat Prover has been directly responsible for much of this record."

The Heat Prover is supplied and maintained free by Cities Service. For further information write Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y.

Calumet Reclamation Operation reclaims stamp sands processed years ago and dumped into lake. Further processing will extract copper. For power, dredge relies on the Calumet Division's Lake Linden Power Plant.

Taking Readings With Heat Prover has helped Calumet Division achieve 86% boiler efficiency. Will aid further in raising KW capacity from 20 to 30 megawatts. The unique instrument enables maximum heat benefits from coal.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

AMERICAN

AUTHORIZED FUEL INJECTION SERVICE

Faithful, economical performance of Diesels equipped with American Bosch Fuel Injection Systems is backed by a world-wide fuel injection service organization . . . staffed with factory-trained technicians . . . using the latest and most efficient methods . . . working with highly specialized equipment designed and built to American Bosch exacting standards.

All this adds up to fast accurate repair work that saves time and money for owners of American Bosch-equipped Diesels. Cost-conscious operators appreciate American Bosch standards that assure them dependable performance and convenient facilities for prompt, reliable servicing.

To find the name of the authorized American Bosch fuel injection service station nearest you in the U.S.A. and Canada, check the directory below:

DIESEL FUEL INJECTION SERVICE STATIONS

ALABAMA

Birmingham, 3	Birmingham Electric Battery Co. — Ave. B & 23rd St. S.

ARIZONA

Casa Grande	Diesel-Electric Service Co. — 202 E. Main St.
Mesa	Perkins Diesel Service — 747 South Country Road
Phoenix	Charlie C. Jones Battery & Electric Co. — 318-322 W. Jefferson St.
Tucson	Auto Plane Electrical Service — 1037 South 6th Ave.
Yuma	Yuma Automotive Electric — 229 8th St.

ARKANSAS

N. Little Rock	Womack Bros. & Taylor — 1219 E. Broadway

CALIFORNIA

Bakersfield	Automotive Diesel & Electric Co., Inc. — 1017 30th St.
Calexico	Calexico Pump & Magneto Co. — 115 East Third St.
Eureka	Gustafson Diesel & Electric — 5th & Commercial Sts.
Fresno	Winther Bros. — 612 Divisadero St.
Los Angeles	Diesel Precision Company, Inc., 4847 Anaheim Telegraph Rd.
Los Angeles, 21	Magneto Sales & Service Co., Inc. — 751 Towne Ave.
Oakland	Diesel Injection & Governor Serv., Inc. — 985 Seventh St.
Oakland	Pimental & Son — 401 Eighth Ave.
Sacramento	Diesel Pump & Injector Service — 414 16th St.
Sacramento, 6	Langner & Rifkin — 1116-22 15th St.
Salinas	Haag Diesel & Electric — 137 Abbott St.
San Bernardino	Diesel Injection Service — 932 Mill Street
San Diego	Electric Diesel & Equipment Co. — 1268 Kettner Boulevard
San Francisco, 24	McKinley Corporation of California — 2196 Palou Ave.
South Gate	Diesel Fuel Injection Lab. — 5775 Meadow Road
Wilmington	Diesel Control Corp. — 218 N. Marine Ave.

COLORADO

Denver, 3	Central Auto Electric Company — 1171 Lincoln St.

CONNECTICUT

Hartford	W. J. Connell Co. of Hartford — 85 Airport Road

DISTRICT OF COLUMBIA

Washington	Diesel & Ignition Service Inc. — 925 Girard St., N. E.

FLORIDA

Jacksonville	Patten Sales Co., Inc. — 1021 Hogan St.
Miami	Dade Diesel Company — 3280 N. W. South River Drive
Miami, 36	Florida Diesel Service Co. — 1930 N. Miami Ave.
Orlando	Interstate Diesel Service — 206 N. Orange Blossom Trail
Tampa	Stuart Diesel Service — 2109 4th Ave.

GEORGIA

Atlanta, 3	Auto Electric & Magneto Co. — 477 Spring St., N. W.
Cairo	Grady Motors — 201-5th St., N. E.

IDAHO

Blackfoot	Auto Parts Service Co. — 95 S. Broadway
Boise	Magneto & Diesel Supply Co. — 2406 Main St.
Lewiston	Osterman Diesel & Electric Co. — 1610 E. Main St.
Twin Falls	Diesel Pump & Injector Service — West Madison Avenue at Ruman Lodge

ILLINOIS

Chicago, 16	Illinois Auto Electric Co. — 2011-37 So. Indiana Ave.
Peoria	Automotive Ignition Co. — 522 Franklin St.
Rock Island	Lohse Automotive Service — 430 17th St

INDIANA

Indianapolis, 4	Gulling Auto Electric Inc. — 450 N. Capitol Ave.
Mentone	Smith Brothers Garage
Valparaiso	Diesel Service Company — 1015 East Lincolnway

IOWA

Cedar Rapids	Hogan's Carburetor & Electric Co. — 209 Seventh St., S. E.
Des Moines	Electrical Service & Sales Co. — 1313 Walnut St.

KANSAS

Great Bend	Bell Engine Service — 3810 West Tenth
Grinnell	Grinnell Electric & Diesel Service Co.
Salina	The Motor Service Company — 8th & Pacific
Wichita, 2	E. S. Cowie Electric Co. — 230 S. Topeka Ave.

KENTUCKY

Louisville	Diesel Injection Service — Shelby at Mulberry St.
Louisville	Schaaf Auto Electric Co. — Broadway at Jackson
Paducah	Story Electric & Battery Co. — 621 Jefferson Street

LOUISIANA

Baton Rouge	Womack Bros. Diesel Service — 3983 Airline Hgw.
Bossier City	Vaughan Tractor & Auto Parts Co. — 601 West First Street
Morgan City	Landry's Diesel Injector Service — 1009 Front Street
New Orleans	Gerhardt's Inc. — 1917 Jefferson Hgw.
New Orleans, 13	John M. Walton, Inc. — 1050 Carondelet St.

MAINE

Portland	Eastern Diesel Service Co. — 997 Congress St.
Portland, 5	Portland Tractor Co., Inc. — 803 Forest Ave.

MARYLAND

Baltimore, 1	Parks and Hull Automotive Corp. — 1033 Cathedral St.
Baltimore	Stephen Seth & Co. — 876 Park Ave.

MASSACHUSETTS

Boston	Boston Fuel Injection & Engine Service — 280 Northern Ave.
Boston, 64	W. J. Connell Company — 210 Needham St.
Boston, 10	Wharf Machine & Electric Co., Inc. — Fish Pier Road
Fairhaven	Hathaway Machinery Co., Inc. — Hathaway-Braley Wharf
Springfield	C. A. Krohne & Sons — 833 Columbus Ave.

MICHIGAN

Detroit	Knorr-Maynard, Inc. — 5743 N. Woodward Ave.
Lansing	Diesel Equipment Sales & Service — 2520 S. Pennsylvania Ave.

MINNESOTA

Hibbing	Diesel Service Company — 1800 Third Ave., East
Minneapolis	Diesel Service Co. — 2509 E. Lake St.
Minneapolis, 2	Reinhard Bros. Co., Inc. — 11 South 9th St.

MISSISSIPPI

Jackson	Womack Brothers — 1305 South Gallatin St.

MISSOURI

Kansas City, 8	Electrical & Magneto Service Co. — 2538 Grand Ave.
St. Louis, 23	Diesel Fuel Injection Service Co. — 9331 So. Broadway
St. Louis, 3	Electric Parts and Service Co. — 2900 Washington Blvd.

MONTANA

Billings	Original Equipment, Inc. — 423 North Broadway
Havre	Midwest Diesel Injection Sales & Service — 901 Third Avenue

NEBRASKA

McCook	Automotive Sales & Service — 44 West "B" St.
Omaha, 2	Carl A. Anderson, Inc. — 16th & Jones

NEW JERSEY

Newark, 2	Tire Trading Company, Inc. — 239 Halsey St.
Trenton, 9	Steinert Diesel Injection Service — Bell Ave. off Klockner Rd.

BOSCH

Keeps Diesels on the job ...everywhere ...anywhere

AMERICAN BOSCH

Springfield 7, Massachusetts

Division of American Bosch Arma Corporation

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NEW YORK

Brooklyn	A & D Diesel Service, Inc. — 145 — 21st St.
Buffalo, 8	Hettrich Electric Service — 1032 Ellicott St.
Hempstead, L. I.	A & D Diesel Service, Inc. — 887 Nassau Rd.
Pelham Manor	Coretti-Gross, Inc. — 44 Secor Lane
Rochester	Union Carburetor & Injection Service — 6 Pitkin St.
Troy	Ehrlich Electric Service, Inc. — 200 Fourth St.
Utica	Stiefvater Electric Co., Inc. — 320-322 Lafayette St.
Woodside, 77	American Bosch Div. American Bosch Arma Corp. 34-21 56th St.

NORTH CAROLINA

Charlotte	Carolina Rim & Wheel Co. — 301 East 8th St.
Raleigh	Diesel Injection Sales & Service — 3015 Hillsboro Road

NORTH DAKOTA

Fargo	Northwestern Diesel Service Co. — 2800 Front St.
Minot	Diesel Service Company — 1521 2nd St., S.W.
Williston	Crighton Motor Co. — 223 E. Broadway

OHIO

Akron	Standard Motor Parts — 200 Carroll St.
Cincinnati	Tri-State Distributing Corp. — Broadway at Eighth
Cleveland, 14	The Cleveland Ignition Co. — 1301 Superior Ave.
Columbus, 15	Columbus Ignition Co. — 211 Neilston St.
Lisbon	Lisbon Diesel & Supply Co., Inc. — 234 East Washington St.

OKLAHOMA

Oklahoma City, 2	American Electric-Ignition Co. — 124 N. W. 8th St.
Tulsa	Magneto Ignition Company — 701 West 5th St.

OREGON

Klamath Falls	Specialized Service Co. — 1434 Main St.
Pendleton	Eds Magneto & Diesel Co. — S. W. 18th & Court St.
Portland, 14	Automotive Products, Inc. — 1700 Southeast Grand Ave.
Roseburg	Diesel Injection Service — 2145 N. Stevens

PENNSYLVANIA

Harrisburg	Penn Diesel Service Co. — 100 Prince St.
Hazleton	Penn Diesel Service Co. — 27th & N. Church Sts.
Mt. Carmel	Gengler's Diesel Service & Sales — 2nd & Orange Sts.
Philadelphia	North American Diesel Injection Co. — 2523 No. Howard St.
Philadelphia	Sullivan Brothers — 1718 Fairmount Ave.
Phillipsburg	Keystone Diesel Inj. Service — Phillipsburg-Clearfield Hgw.
Pittsburgh, 6	Automotive Ignition Co., Inc. — 6358-6364 Penn. Ave.

SOUTH CAROLINA

Charleston	Diesel Fuel Injection Service 208 Savannah Hgwy., P. O. Box 512
Columbia	Boney Diesel Works Co., Inc. — Leesburg Road

SOUTH DAKOTA

Lemmon	Josund Auto Electric — 15 First Ave.
Rapid City	Hoseth Auto Electric — 324 St. Joseph St.
Sioux Falls	Reinhard Brothers Company — 225 E. 11th St.

TENNESSEE

Knoxville, 15	Diesel-Magneto Service Co. — 1423 Island Home Ave.
Memphis, 4	Automotive Elec. Service Co. — 982 Linden Ave.
Nashville	Precision Parts Corp. — 400 N. First St.

TEXAS

Dallas, 1	Beard & Stone Electric Co., Inc. — 3909 Live Oak St.
El Paso	Reynolds Batt. & Mag. Co. — 801 Myrtle Ave.
Houston, 1	Beard & Stone Electric Co., Inc., 805 Polk Ave., P. O. Box 1717
Houston	Diesel Pump & Injector Service — 6632½ Navigation Blvd.
Houston	Magneto & Diesel Injector Service — 6931 Navigation Blvd.
Odessa	Electric Service & Supply — P. O. Box 1417
Pampa	Radcliff Bros. Elec. Co. — 519 S. Cuyler St.
San Antonio	S. X. Callahan — 425 N. Flores St.
San Antonio	Womack Bros. — 123 Carolina St.

UTAH

Salt Lake City	Diesel Electric Service & Supply Co. — 60 East 13th Street
Salt Lake City	Midwest Service & Supply Co. — 1333 S. Main St.

VIRGINIA

Norfolk	Diesel Injection Sales and Service — 808 Union St.
Richmond	C. H. Woodward Electric Co., Inc. — 709 W. Broad St.
Salem	Diesel Injection Sales & Service — 814 E. 8th St.

WASHINGTON

Seattle	Seattle Injector & Electric Co. — 2706 Second Ave.
Spokane	Spokane Diesel & Electric Co. — 704 E. Pacific Ave.
Spokane	Sunset Electric Co. — North 703 Division St.
Walla Walla	Walla Walla Motor Supply, Inc. — 128 E. Alder St.
Yakima	Diesel & Electric Service Co. — 1506 So. First St.

WEST VIRGINIA

Charleston	Mountain Service — 6414 McCorkle Ave.

WISCONSIN

Milwaukee, 2	Wisconsin Magneto Company — 918 N. Broadway

WYOMING

Casper	Cotter Battery & Electric Company — 402 E. 2nd St.

ALASKA

Anchorage	Automotive Diesel Electric Supply & Overhaul 2424 E. 5th Ave.
Juneau	Van's Diesel Service — 199 2nd Ave.

CANADA

Calgary	Hutton's, Ltd. — 131 — 11th Ave., W.
Edmonton	Smith Battery & Auto Electric — 10125 — 105th St.
Fredericton	Stairs Bros. Fuel Injection Service Station 493 Northumberland St.
London	Universal Ignition & Battery Ltd. — 324 York St.
Montreal	International Electric Co., Ltd. — 1037 Bleury St.
Montreal	Northam Equipment, Ltd. — 4135 Rouen St.
Quebec	Quebec Gas & Diesel Engines, Ltd. 145-147 rue Prince Edouard
Regina	Electric Motor Service — 1734 Broad St.
St. John's (Newfoundland)	A. H. Murray & Co., Ltd.
Saskatoon	Lambert Electric, Ltd. — 114-116 Ave. A, North
Toronto	A. Cross & Co., Ltd. — 6 Spadina Ave.
Toronto	Auto Electric Service Co., Ltd. — 1009 Bay St.
Vancouver	Fred Holmes Fuel Inj. Sales & Service Ltd. — 627 Bidwell St.
Vancouver	Jeffree & Jeffree, Ltd. — 775 Homer St.
Vancouver	MacFarlane & Co., Ltd. — 1955 Columbia St.
Vancouver	Vivian Diesels & Munitions, Ltd. — 1660 Station St.
Winnipeg	Brown & Murray, Ltd. — 237-241 Fort St.

HAWAII

Honolulu	Honolulu Iron Works Company — 28 No. Queen St.
Honolulu	Todoki Machine & Marine Works — 810 Halekauwila St.

PUERTO RICO

San Juan	General Farm Equipment Co. 742 Las Palmas Ave., Stop 12, Miramar

(List of foreign service stations available on request)

Random Thoughts from a Filter Engineer

by Charles Meyer

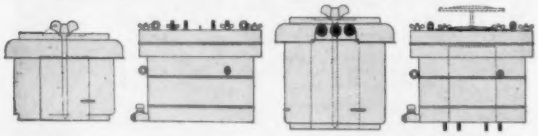
- **MAKING LIFE EASIER FOR ENGINEERS**
- **WHY WE SOMETIMES RECOMMEND LARGER FILTERS THAN COMPETITORS**
- **SOME COMPROMISES ARE NECESSARY**

MAKING LIFE EASIER FOR ENGINEERS

We have great sympathy for those engineers who have the job of installing engines in factories. Many plant layouts give them very little room to work in. Often they are faced with the problem of needing a filter of a certain size and having no place to put it. We at Air-Maze have tried to remedy the situation. We've made our oil bath filters in a variety of designs.

Some oil bath filters have an air outlet at the bottom so that the filter can be mounted directly on the intake pipe.

Types of Air-Maze Oil Bath Air Filters



Some have an outlet at the top so that the filter can be suspended from an elbow. Others have an outlet at the side to attach to the horizontal piping from the engine.

In addition, most of our oil bath designs can be obtained with or without a silencing chamber to dampen engine intake noise. And a number of designs can be obtained with a relief valve to prevent oil blowout from intake pulsation or a backfire relief valve to provide protection against engine backfires.

WHY WE SOMETIMES RECOMMEND LARGER FILTERS THAN COMPETITORS

Sometimes a prospective customer asks us why we recommend a larger filter than a competitor does. Especially when the competitor claims his filter will do the job. It all goes back to something we learned a long time ago. When recommending a filter for a particular installation, select the filter that will handle the *velocity*, not just the *volume*. There's an old saying in the trade: the only language a filter understands is air velocity. Just as a bridge must be designed for the greatest load it will have to sustain, so a filter must be selected for the greatest velocity it will have to take at any given moment.

There's no problem selecting a filter for turbochargers and blower-type scavenging devices. They provide a relatively constant flow of air. But with compressors, slow speed engines and scavenging pumps (particularly where there is an overlap of pistons), the air flow at one instant may be much greater than the average flow per minute.

Air-Maze was one of the first to recognize this situation. We've devised formulae, based on hundreds of tests, that helps us select the proper filter. That's why we occasionally recommend a larger filter than may seem necessary or a larger one than a competitor may recommend. Experience shows that the larger filter avoids such future difficulties as oil pull-over or damage from pulsation.

SOME COMPROMISES ARE NECESSARY

The word "compromise" has fallen into disfavor in the minds of many people. When we speak of a type of filter being a compromise, they're inclined to think the product isn't as good as it could be. Actually, every type of filter is a compromise. A dry type filter has a certain set of advantages that an oil bath filter doesn't have. To gain one quality you often have to sacrifice another. It depends upon *which* set of qualities you want in a filter.

For instance, a dry type filter can be designed to provide very high efficiency with small air-borne particles where it's important that the filter have no oil coating. It's ideal for carbon ring compressors where no oil can be tolerated. When a filter must be installed in anything but a vertical position, dry filters should be used. For example, an aircraft in inverted flight. Or any equipment that has a tilt of over 30 degrees. And a dry filter may be better than an oil bath filter in areas of extremely high dirt concentration because oil bath filters can't wet and collect the dirt fast enough.

Dry filter vs. Oil bath?

But a dry filter doesn't have the dirt holding capacity of an oil bath filter. Our 6500 CFM capacity oil bath filter can hold over 100 pounds of dirt. And it's not affected by high humidity conditions or oil fumes in the air. Oil bath filter media is permanent. In normal operation, it doesn't need replacement. But dry type filter media needs cleaning and eventual replacement.

We at Air-Maze have no ax to grind. We make both dry type and oil bath filters. Regardless of which set of advantages your filter installation calls for, we have the filter to do the job. The Air-Maze Corporation, 25000 Miles Road, Cleveland 28, Ohio.

AFI MEMBER AIR FILTER INSTITUTE

AIR-MAZE

The Filter Engineers

AIR FILTERS • SILENCERS • SPARK ARRESTERS
LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

SCHWITZER
TURBOCHARGERS

OVER ONE HUNDRED MILLION MILES OF PROVEN COMMERCIAL OPERATION

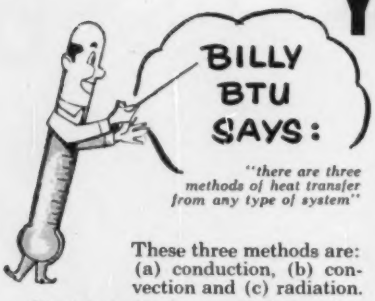
With 30 Years of Extensive Research and Production Experience in the Supercharging Field, Schwitzer Now Offers a Complete Line of 4 Sizes of Turbochargers For 50 to 1200 HP Installations. Now in Production in All Heavy Duty Fields—Truck-Tractor-Stationary-Marine.

SCHWITZER
CUMMINS COMPANY
INDIANAPOLIS, INDIANA

Young Heat Transfer News

YOUNG RADIATOR COMPANY, RACINE, WIS.

Utility Cools Compressed Gas with Young Atmospheric Radiators



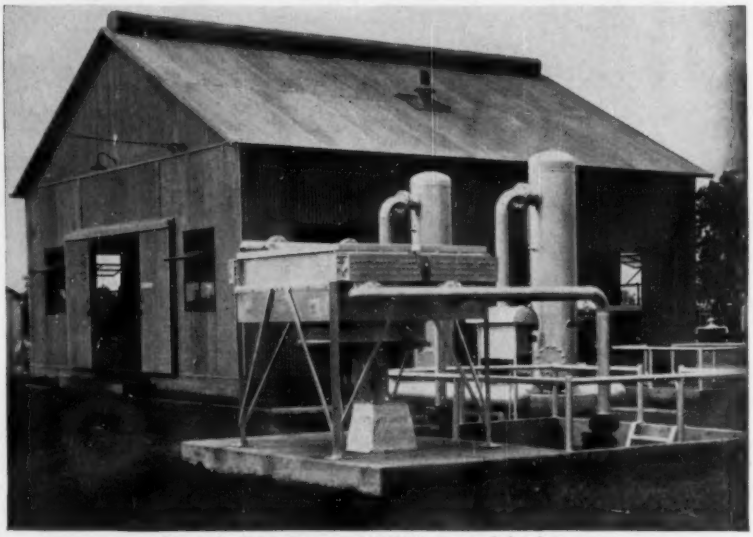
"there are three methods of heat transfer from any type of system"

These three methods are: (a) conduction, (b) convection and (c) radiation.

Heat transfer by conduction exists when heat flows within a body from one region of high temperature to another region of lower temperature by simple molecular communication. The amount of heat which can be transferred by conduction is dependent on the temperature difference, thermal conductivity of the material through which the heat is being conducted, the distance between the hot source and the cold sink, and the cross sectional area for heat flow.

Transfer of heat by forced convection depends on the velocity of the fluids over the surface through which heat is conducted . . . by the shape of the surface, by the area through which heat is conducted . . . and by various properties of the fluid as well as temperature difference.

The third general means of heat transfer is radiation. Here heat flows from the body of the higher temperature to the body of the lower temperature through space without any medium within the space. For further details on this subject write for free bulletin: "Heat: Forced Convection Removal From Industrial Hydraulic Circuits" to Young Radiator Company, Dept. 415-J Racine, Wis.



Young Radiator Company "HC" Cooler and Condenser.

Southwest Natural Gas Company, Ada, Oklahoma, uses Young Radiator Company HC* Horizontal Core Cooler to cool compressed gas stored underground during the summer. Gas is withdrawn during the peak winter loads to supplement pipeline capacity into the City of Ada and nearby points.

Cooling is necessary because higher temperatures are detrimental to the porosity of the formation underground into which the gas is stored.

In addition compressors inside the building are equipped with Young Radiator Company "Mono-Weld" Jacket Water Coolers.

These efficient "HC" Units are also used for cooling water, oil and other gases and for condensing steam and vapors. They combine the efficiency of vertical air discharge with the economy of compact Young design . . . and the versatility of multiple unit combinations. Cooling cores are available in plate fin, Monofin or spiral fin construction for any operating pressure. Fans are mounted independently on special tripods completely eliminating vibration, a major cause of core failure. For full details on "HC" cooling units see your nearest Young representative or write Young Radiator Company, Dept. 415-J Racine, Wisconsin.

* HC is a Young Radiator Company trademark.

NEW FIXED TUBE BUNDLE HEAT EXCHANGER CATALOG

A complete description of stock and specially engineered Young Radiator Company Type "F" Fixed Tube Bundle Heat Exchangers is given in the newly revised Catalog No. 1254. For your copy, write Dept. 415-J Young Radiator Company, Racine, Wis.

Young RADIATOR COMPANY

RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY

Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

Five things to remember when you buy diesel lubricants

1. Pure Klondyke Series Lubricants
Specially made naphthenic-type pale oils for slow speed two-cycle engines.

2. Purodiesel Series Lubricants
High-grade inhibited oils particularly suited for two- and four-cycle engines not in heavy-duty use.

3. Purodiesel XD Series Lubricants
Specially compounded for two- and four-cycle engines in mild heavy-duty operation.

4. Pure Sultana X Series Lubricants
Highly compounded heavy-duty oils for two- and four-cycle engines in high-speed, heavy-duty service.

5. Pure Sultana SHD Series Lubricants
Specialty oils designed for supercharged engines and engines operating on fuel with a high sulfur content.

***Free* used oil analysis foretells engine trouble . . . saves costly repairs**

Don't guess about the condition of the lubricating oil in your engine. A pint sample of used oil subjected to Pure's analysis system will permit our technicians to determine this and report to you any need for adjustments. To get this FREE Pure-sure Used Oil Analysis, send coupon today!

Offer is limited to areas where Pure Oil products are sold.

BE SURE WITH PURE — PURE

PURE OIL DIESEL LUBRICANTS

The Pure Oil Company, Dept. D-59
35 East Wacker Drive
Chicago 1, Illinois

Send me information on how I may obtain a Pure-sure Used Oil Analysis of my used diesel lubricating oil without cost or obligation.

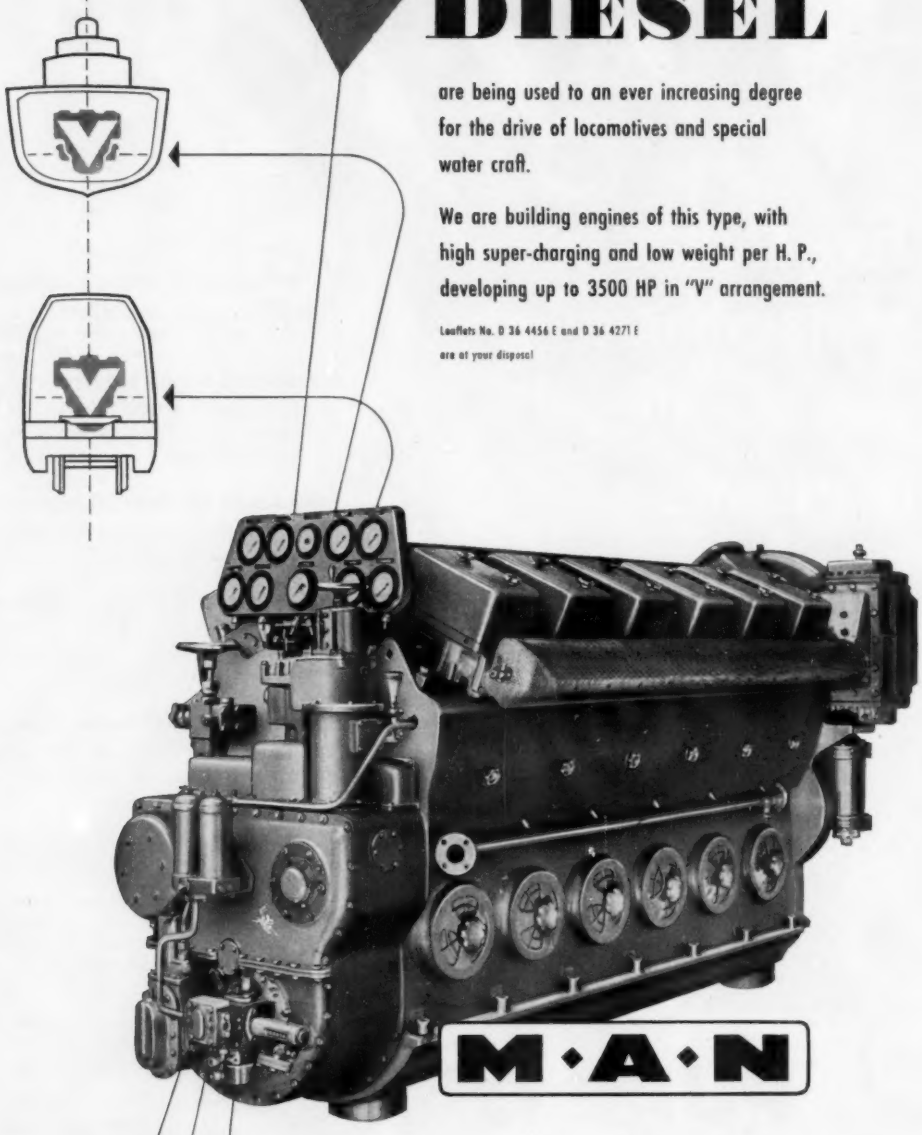
Name_____
Position_____
Company_____
Address_____
City_____ Zone____ State____

V DIESEL

are being used to an ever increasing degree for the drive of locomotives and special water craft.

We are building engines of this type, with high super-charging and low weight per H. P., developing up to 3500 HP in "V" arrangement.

Leaflets No. D 36 4456 E and D 36 4271 E are at your disposal



M·A·N

MASCHINENFABRIK AUGSBURG-NÜRNBERG AG · WERK AUGSBURG

We are represented in all countries.
Please ask for name and address
of your local representative.

20 out of 22 crawlers drive through torque converters

. . . and they're all Twin Disc!

Of the 22 crawler tractors working on the first section of the Indiana Toll Road now under construction—*20 are equipped with Twin Disc Torque Converter Drive!*

Why this top-heavy proportion of Torque Converter crawlers? Let's ask H. T. Lattimore, general superintendent for Suber & Co., of Whitmire, S. C., the contractor with the earth-moving contract for the first 12-mile stretch.

"We prefer Torque Converter crawlers," says Mr. Lattimore, "because they give us more usable power, and more power *means more work done every day.* The Torque Converters cut out engine lugging, cut down on shifting and clutching and make it a lot easier for our operators to match tractor power to the load. Operators move more dirt and are less tired after a full day's work on a tractor with Torque Converter Drive."

Throughout the construction industry, more and more contractors are carefully checking the performance of Torque Converter-equipped tractors . . . and arriving at the same conclusions! That's why *all three* of the "Big 3"—Allis-Chalmers, Caterpillar and International, manufacturers of the most powerful crawler tractors now available—have standardized on Twin Disc for their Torque Converter Drive models!

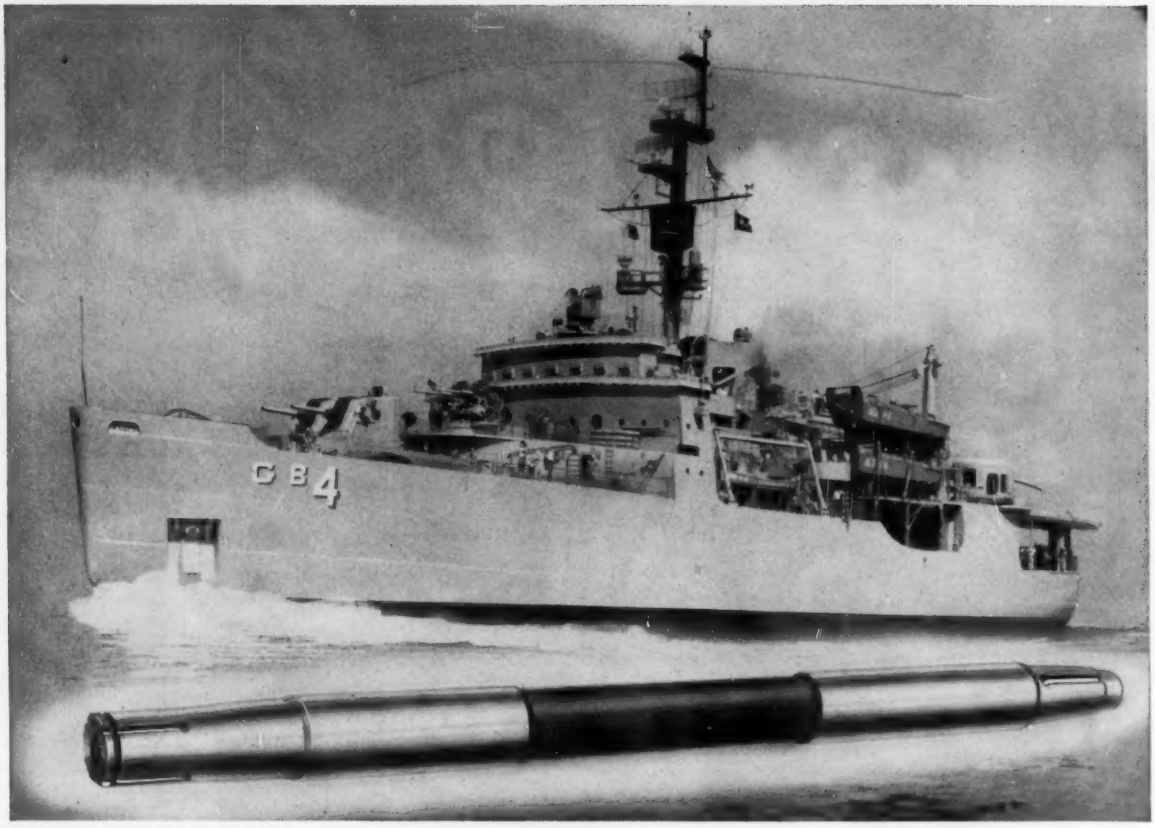
Be sure there is a Torque Converter Drive in the next tractor you order. Check with your dealer today for complete information on Torque Converter Drive — and the tremendous increase in *drawbar pull* it will give your tractors.

Photo — Excavating on the Indiana Toll Road, Suber & Co. is working ten HD-20, six new HD-21, one HD-15AC Allis-Chalmers and three TD-24TC International crawlers—a total of 20 out of their 22 tractors on the job *driving through Twin Disc Torque Converters!*

TWIN DISC

TWIN DISC
Torque Converters

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydralic Division) Rockford, Illinois

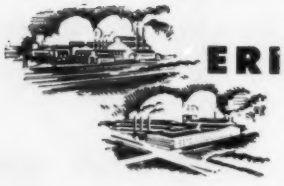


OFFICIAL UNITED STATES NAVY PHOTOGRAPH
COURTESY OF THE INGALLS SHIPBUILDING CORPORATION

HORSEPOWER GOES TO SEA —

Another Erie Shaft Drives this Navy Ice Breaker

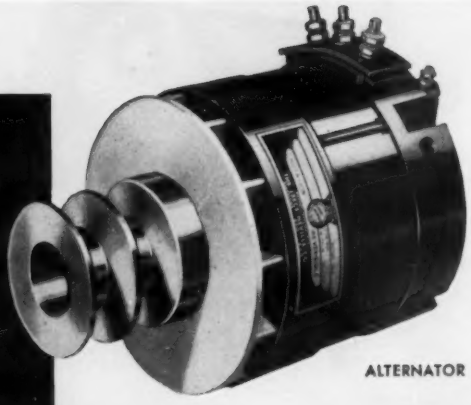
We use the word "another" because we have produced literally thousands of forged steel components for Diesel and Marine use. From raw material to finished product, under one control and with a single responsibility, forged steel cranks, drive shafts, connecting rods, special forgings for processing equipment and a diversity of steel castings for heavy industry are our daily accomplishment. Isn't it quite logical, then, to place your forged and cast steel components requirements with us? We shall welcome opportunities to consult with you.



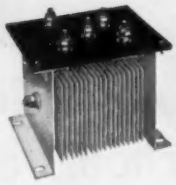
ERIE FORGE & STEEL CORPORATION

ERIE, PENNSYLVANIA

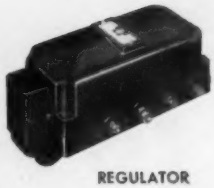
Leece-Neville



ALTERNATOR



RECTIFIER



REGULATOR

New AC-DC ALTERNATOR SYSTEM DELIVERS *125* Amps

Weighs only 44 lbs.
Costs much less than comparable d.c. system

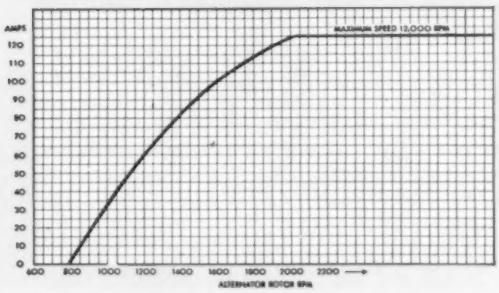
At the price you formerly paid for a 100 ampere L-N Alternator System, you now get 125 amperes . . . and at a cost far below that of a d.c. generator.

Built on a 6⅝ inch diameter frame, the Alternator weighs only 27 lbs. Rectifier and Regulator bring the total weight of the generating system to only 44 lbs. Compare that with the weight of a d.c. generator of the same output and you'll find an important weight saving.

The performance curve shows the low cut-in speed and rapid attainment of full output. Charging current at engine idle speed will vary with drive ratio.

This new L-N Alternator System is ideally suited for many types of vehicles with 12 volt electrical systems: buses, trucks, trolley coaches, school buses, fire trucks, mine and construction equipment. For applications requiring a fan-cooled rectifier, an Alternator with a shaft-mounted fan at rear is available.

PERFORMANCE AT 12 VOLTS



There are L-N Alternators with capacities ranging to 95 amperes for 6 volt systems; to 180 amperes for 12-volt; to 100 amperes for 24 volt; and to 50 amperes for 32 volt. All of them have the rugged design and precision manufacture that give L-N Alternators unmatched reliability and long life. Be sure to specify Leece-Neville.

Since 1946, L-N Alternators have been helping fleet owners cut operating and maintenance costs. For all the facts, write The Leece-Neville Company, Cleveland 3, Ohio. *Distributors in principal cities . . . service stations everywhere.*

YOU CAN RELY ON Leece-Neville

Automotive Electric Equipment Since 1909

TRUCK • BUS • DIESEL • INDUSTRIAL • PASSENGER • RAILROAD • MARINE • OFF-HIGHWAY

ALTERNATOR SYSTEMS

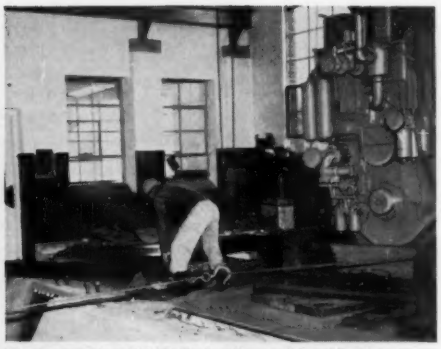
D C GENERATORS

CRANKING MOTORS

REGULATORS

SWITCHES

SMALL MOTORS



The Enterprise DGSQ Turbocharged Dual Fuel engine is moved into place as a unit. With 16" bore and 20" stroke, it is rated 1422 HP at a speed of only 360 RPM.

Fourth Enterprise Engine arrives at Belleville under protective wraps of all-weather tarpaulin. This new addition adds 1000 KW to plant's capacity.

Bright Power Picture at Belleville: Better Schools and Streets, with Lower Taxes!

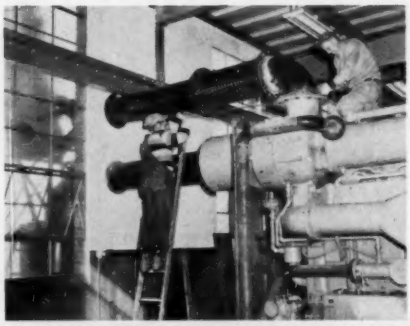
"We recently installed the fourth Enterprise Engine in our 100% Enterprise Dual Fuel plant. Our excellent experience with this equipment over the past eight years has proved it to be our best buy in engines. Operating and maintenance costs have been consistently low, greatly reducing power costs and helping make Belleville one of the most thriving and progressive cities in the middle west. We have better schools and streets, lower taxes, above-average recreational facilities, and many other advantages enjoyed by only very few cities of similar size."

Earl E. Whitney, City Manager
Belleville, Kansas

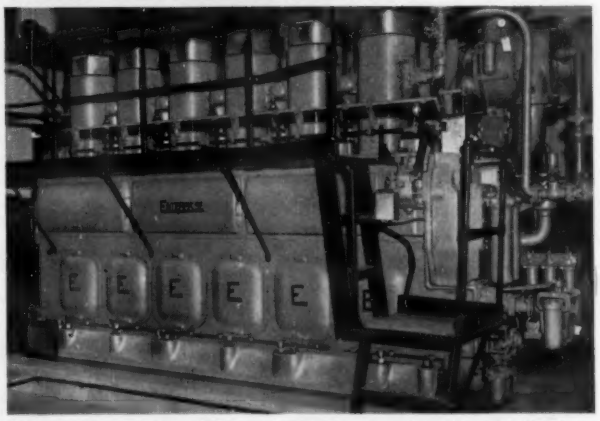
City managers, municipal engineers, superintendents — all those concerned with the growth, the future, the prosperity of their community, can look to Enterprise Engines confident they will get this same kind of dependable and economical power-generating performance.

Enterprise Engines — Diesel, Dual Fuel, Spark Ignited Gas — serve every municipal need

The most modern engineering advances are reflected in every Enterprise model, from 73 to 6933 HP, for stationary or portable electric service, flood or water pumping systems, sewage plant power. See the Enterprise sales engineer in your area, or contact us direct for information or help with your plans.



Installation nears completion as exhaust stack and muffler are installed. This "all Enterprise" plant, with its 2500 KW capacity, now has ample dependable reserve power for any emergency, future growth.



New member of the all Enterprise power team is cut in on the line. Low maintenance cost, excellent service record, and over-all economy of the Enterprise engines already in use were the big factors in its selection.

Over a million horsepower at work the world over!

ENTERPRISE
dependable **ENGINES**

ENTERPRISE ENGINE & MACHINERY CO.
Subsidiary of General Metals Corporation
18th and Florida Streets, San Francisco 10, California
Export Department, New York

Boston • Chicago • Denver • Jacksonville • Kansas City • Los Angeles • Minneapolis • New Orleans • New York • San Diego • Seattle • St. Louis • Washington, D.C.

It's time you asked:

What's behind the success of aluminum bearings?

Since Alcoa first introduced them in 1938, aluminum bearings have been making deep inroads where bimetallic bearings were considered standard. Little by little, management groups in all industries have seen competitors' problems solved by the adoption of them—and hundreds have asked, "What IS behind the success of aluminum bearings?"

For one thing, aluminum bearings are *one piece.* Heat is evenly distributed, quickly dissipated. The relative softness of aluminum bearing materials prevents scoring of shafts by dirt particles. Yet aluminum is hard enough to groove slightly, and "roll out" particles, and allow them to be trapped by the oil filter. What's more, these long-lasting bearings in many cases actually *cost less than the bearings you're now using!*

Alcoa's team of research and development engineers spent years in the development of this special bearing alloy. These men, already familiar with the railroad industry, knew the alloy must have optimum resistance to corrosion; must offer the last word in load-carrying ability.

Working hand-in-hand with Fairbanks-Morse, these Alcoa engineers developed, machined and installed the world's first aluminum bearings for diesel locomotives. Now, after years of trouble-free experience with them, Fairbanks-Morse specifies Alcoa® Aluminum Bearings for the full engine set in their great new TRAIN MASTER Locomotive!

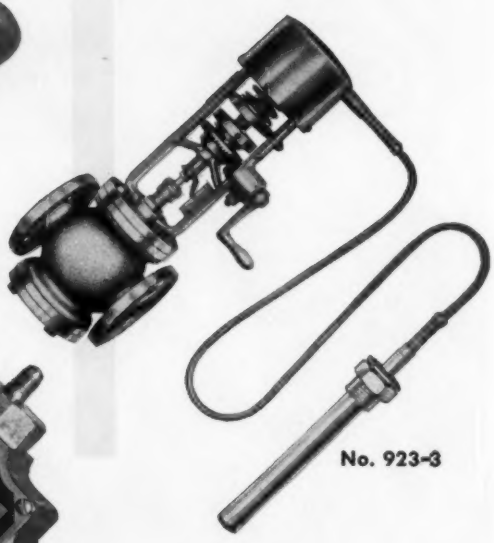
So, it's time you asked, "What's behind the success of aluminum bearings?"—and the man to ask is the Alcoa sales engineer, or call your nearby Alcoa sales office. The number is listed under "Aluminum" in the classified section of your telephone directory. Or write: ALUMINUM COMPANY OF AMERICA, 1988-J Alcoa Building, Pittsburgh 19, Pennsylvania.

Your Guide to Aluminum Value

WE CHOSE ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA
©ACOA

FASTEN ALUMINUM WITH ALCOA ALUMINUM FASTENERS

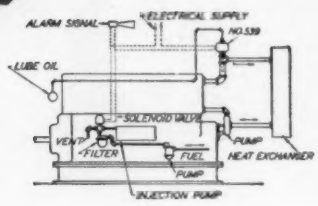
Why take chances on engine trouble?



No. 923-3

Depend on SYLPHON controls

No. 539



Typical installation of No. 539.

YOU NEVER NEED to cross your fingers —or trust to luck—with these Sylphon controls. When they're on the job, they safeguard you against engine trouble—day and night. They help ward off costly shutdowns, damage or repairs.

No. 539 control gives positive protection against high jacket water temperature or low lube oil pressure. If water jacket temperature goes above, or lube oil pressure goes below safe limits, it sounds an alarm—or shuts off the engine. Also available for temperature or pressure only.

No. 923-3 Regulator is equally dependable. It thermostatically controls cooling water circulation—keeps engine jacket temperature right. Can be manually operated —if and when desired!

Both controls are ideally suited to diesel, gas or other internal combustion engines. Self-contained and self-powered, they're built to give you long, trouble-free service. Easily installed. For complete information, send for Bulletin ND-817.

Robertshaw-Fulton
CONTROLS COMPANY

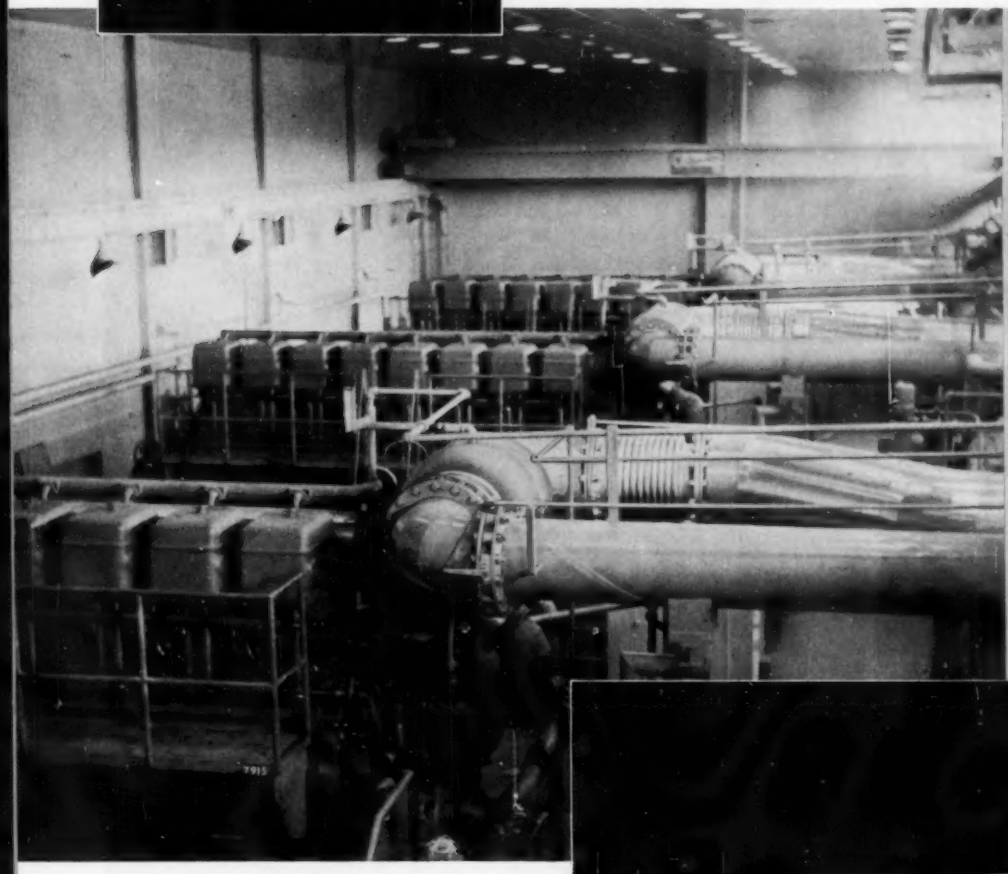
FULTON SYLPHON DIVISION

Temperature Controls • Bellows Devices • Bellows Assemblies

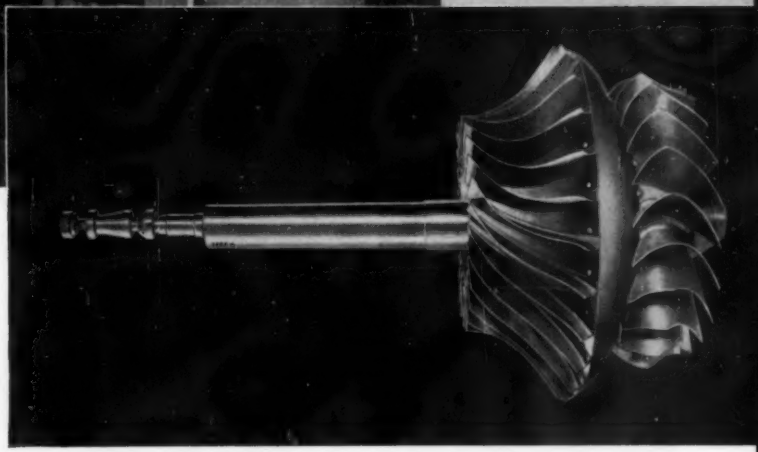
KNOXVILLE 1, TENNESSEE

DE LAVAL
HIGH PRESSURE TURBOCHARGERS

efficiently serve diesels at Lakehead Pipe Line Company



Exclusive
MONOROTOR
Construction



Located in an outlying district in Northern Minnesota, this oil pumping station of the Lakehead Pipe Line Company must have *dependable, efficient* equipment. That's why Nordberg Diesel engines *with De Laval High Pressure Turbochargers* were chosen for this service.

The De Laval turbochargers efficiently utilize the exhaust gases to supply the high intake air requirements of these 1800 BHP, eight cylinder, four-cycle Supairthermal engines. Shown in the photograph are three units. Six other identical engines operate in pairs in three other stations of this company.

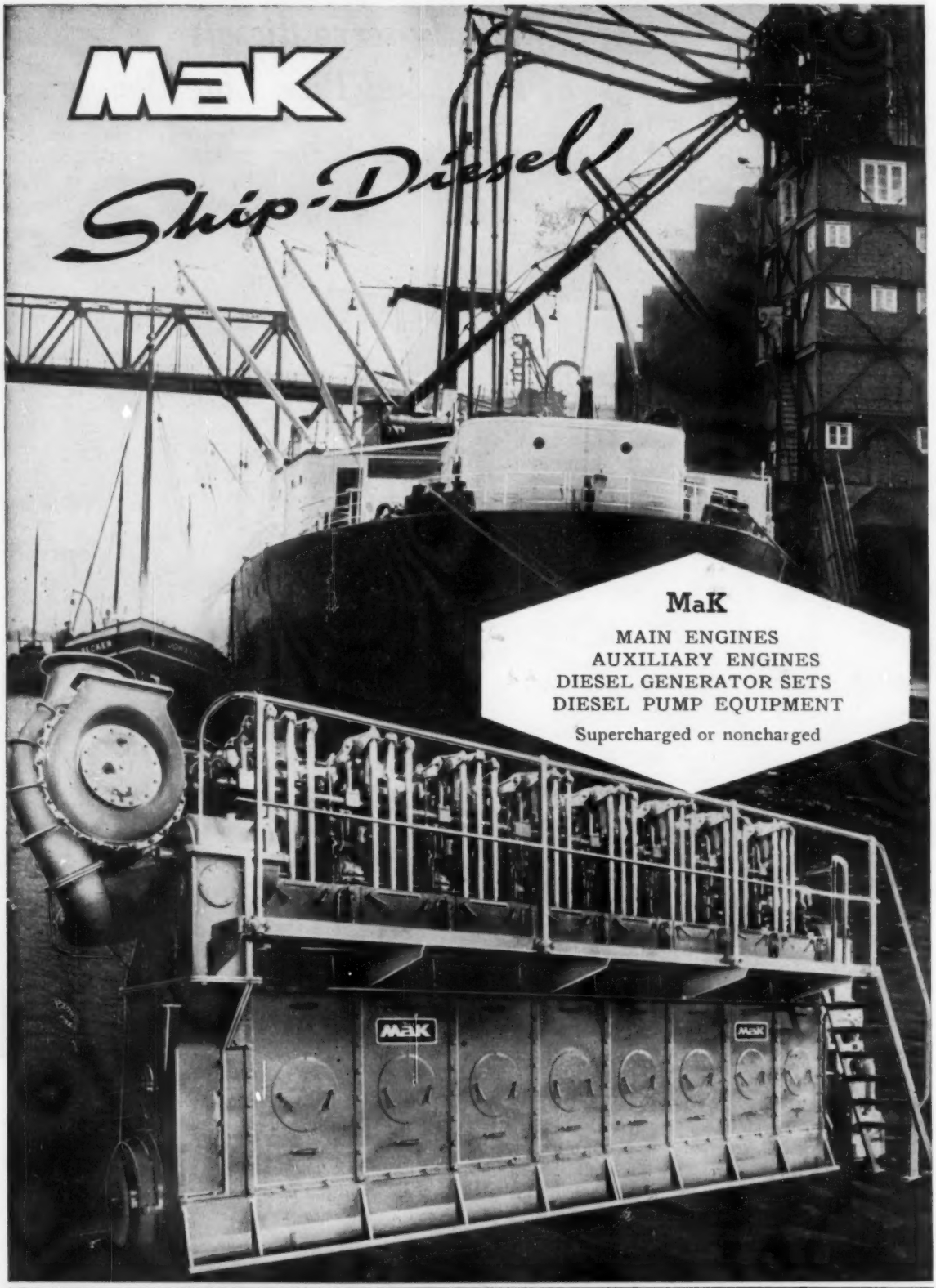
Due to the exclusive Monorotor design, De Laval High Pressure Turbochargers have a pressure ratio up to 3:1, as well as far higher pressure and turbine efficiencies than those found in conventional turbocharger systems. They are self-adjusting to engine loads, can be used with 4- *and* 2-cycle engines.

Write for De Laval Bulletin 8000 giving comprehensive curves and flow range diagrams.

DE LAVAL *Turbochargers*

DE LAVAL STEAM TURBINE COMPANY
890 *Nottingham Way, Trenton 2, New Jersey*

DL 324



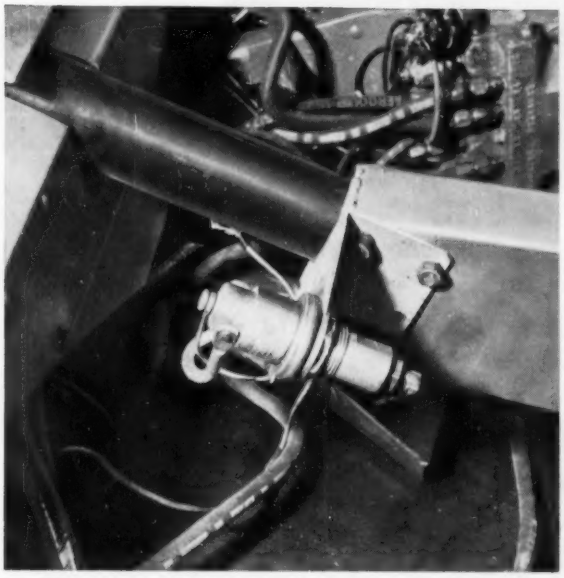
MASCHINENBAU KIEL AKTIENGESELLSCHAFT

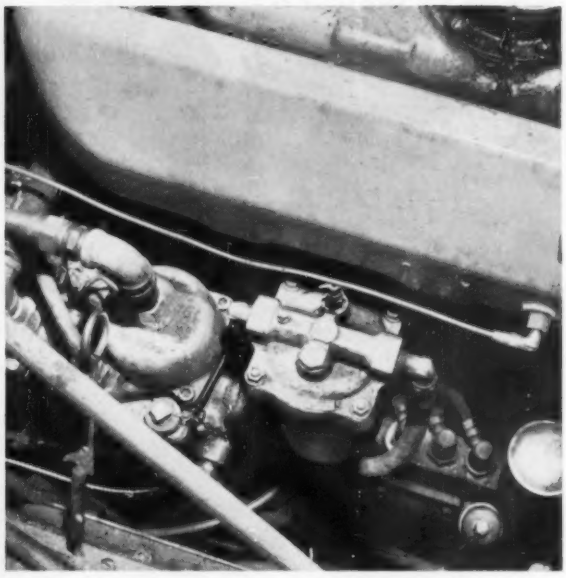
GERMANY

The Engineer's Field Report

CASE HISTORY
PRODUCT Chevron Pressure Primer System
FIRM Consolidated Freightways Inc., Portland, Oregon

Pressure Primer System starts diesels on 1st or 2nd turn with regular batteries—at minus 40°





BELOW ZERO starting temperatures are common 5 months a year for Consolidated Freightways equipment operating in Mountain and Plain States. Two hundred and forty-four of the company's tractors are equipped with the Chevron Pressure Primer System. Since this installation, rigs start on first or second turn at 40° below zero—using regular equipment batteries! Normally in these sub-zero temperatures, regular batteries give out after about 4 turns. Sure starts plus the fact engines are primed with Chevron Pressure Primer bulbs, controlled from within the cab, saves Consolidated Freightways important man-hours and speeds operating schedules. Picture above (left) shows a Chevron Pressure Primer Discharger mounted on steering column. Highly volatile priming fuel is atomized through tubing into manifold (right) under 250 lbs. pressure.

FREE FOLDER tells you more about Chevron Pressure Primer System and how to install it on different engines. Write or ask for it today.

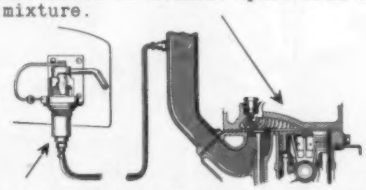
FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor, write or call any of the companies listed below.

CHEVRON

TRADEMARK "CHEVRON" REG. U. S. PAT. OFF.

Why Chevron Pressure Primer System helps starting

Volatile Chevron Priming Fuel atomizes in induction system at temperatures as low as -65°F. Pressure or weakest spark from engine fires mixture.



Simple, rugged discharger prevents fuel leakage. Small, safe steel bulbs protect fuel from water and dirt.

STANDARD OIL COMPANY OF CALIFORNIA, San Francisco 20 • STANDARD OIL COMPANY OF TEXAS, El Paso
THE CALIFORNIA OIL COMPANY, Perth Amboy, New Jersey • THE CALIFORNIA COMPANY, Denver 1, Colorado

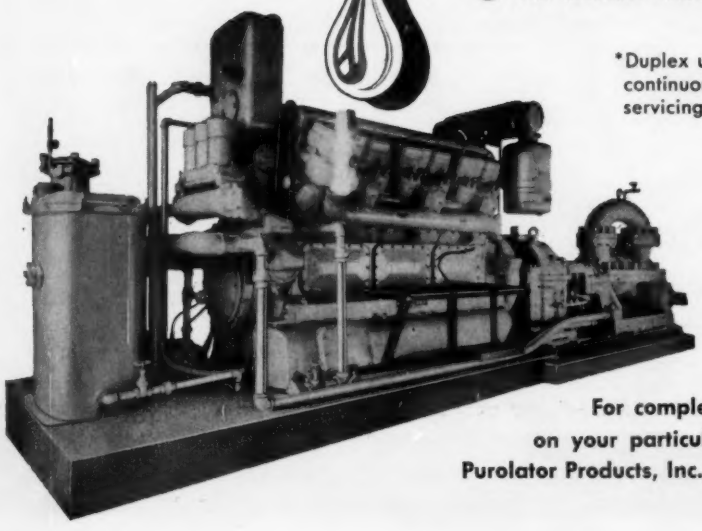
For positive filter protection . . .

CHECK THESE 5 POINTS WITH PUROLATOR

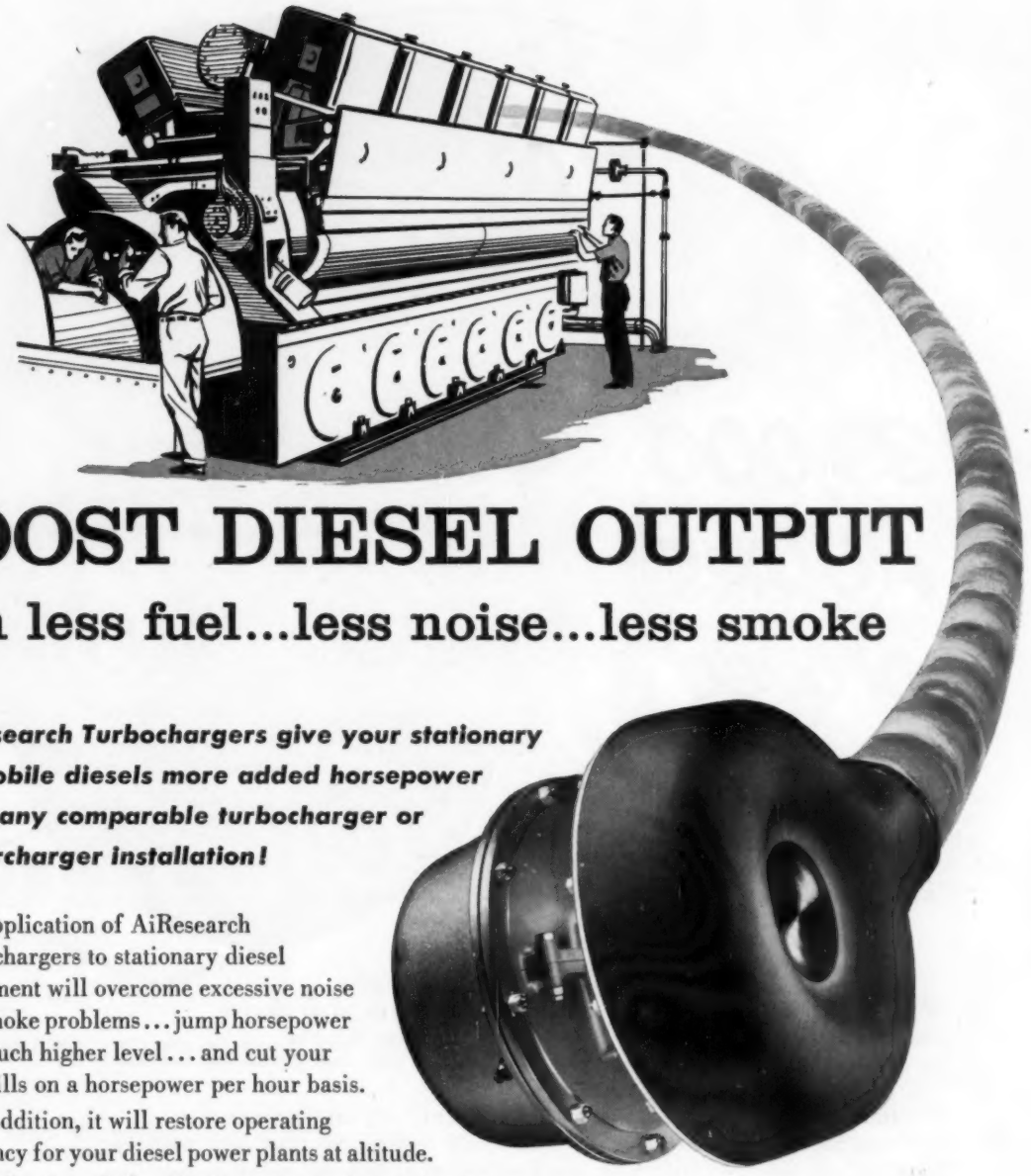
"FIRST in the field of filtering"

- Full flow lubricant filtration
- Micronic filtration of fuel to the injector pump *
- Individual filter protection for each nozzle
- Metal edge filter to protect fuel transfer pump *
- Air intake filtration

*Duplex units available for continuous operation while servicing filter elements.



For complete technical filter data on your particular diesel application, write to Purolator Products, Inc., Dept. DL1-911, Rahway, New Jersey.



BOOST DIESEL OUTPUT

with less fuel...less noise...less smoke

AiResearch Turbochargers give your stationary or mobile diesels more added horsepower than any comparable turbocharger or supercharger installation!

The application of AiResearch Turbochargers to stationary diesel equipment will overcome excessive noise and smoke problems... jump horsepower to a much higher level... and cut your fuel bills on a horsepower per hour basis.

In addition, it will restore operating efficiency for your diesel power plants at altitude.

Application of these finely engineered power packages to mobile diesel equipment is equally effective... as has already been demonstrated in the remarkable results achieved by the installation of AiResearch Turbochargers on Caterpillar diesel machinery.

AiResearch is the largest producer of small turbomachinery in the United States, with twenty-five *million* hours of experience. This unmatched experience explains why AiResearch Turbochargers lead in power, economy and dependability. Your inquiries are invited.

THE GARRETT CORPORATION

AiResearch Industrial Division

9225 Aviation Blvd., Los Angeles 45, California

DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND RELATED MACHINERY

"33,000 HOURS proved the choice was right!"

When a prominent North Carolina community converted its power plant to diesel operation, it called in Sinclair Lubrication Engineer Jim Holt for his recommendations on proper lubricants.

Mr. Holt reports, "I recommended Sinclair RUBILENE® My previous experience convinced me that this diesel lubricating oil would provide maximum wear protection for this power plant's six 1000 K.W. diesel engines. RUBILENE also guards against sticking rings and prevents excessive wear of cylinders, pistons and other moving parts operating continuously for long periods.

"RUBILENE was the right choice," Mr. Holt continues. "After 33,000 hours of near-continuous operation, bearings show very little discernible wear – and there's not a sign of erosive or corrosive action. *Oil consumption is remarkably low,* considering the prolonged operating hours under overload. All six 1000 K.W. engines, with a total output of 6400 K.W. per hour, *use a total of only 1 barrel of oil a day!*"

Why not give a Sinclair Lubrication Engineer the chance to help solve *your* lubrication problem. *There's no obligation.* Contact your local Sinclair office or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

Cutaway view of Deutz Air-Cooled V-type Diesel, showing finned design around combustion area. Heads and cylinders easily removed individually -

DEUTZ

the world's first full line of

AIR-COOLED DIESELS

With a vast record of successful routine performance in temperatures ranging from 140°F to —40°F, DEUTZ Air-Cooled Diesels are known the world around as the rugged power units that feature dependability, simplicity, and economy.

DEUTZ Air-Cooled Diesels are built with horsepower ratings from 5 to 250, and in 1, 2, 3, 4, 6, 8 and 12-cylinder models. Their air-cooling system provides easier, quicker starting and faster warm-up. They operate at higher temperatures which yield higher efficiency and freedom from corrosion problems related to sulphur content of most fuels.

The greater accessibility of engine parts, with each cylinder and head removable separately in the absence of surrounding water jackets, greatly expedites inspection, maintenance, or repair work when necessary.

DEUTZ also builds special water-cooled Diesels from 3 to 2000 HP for automotive, marine and stationary use.

DEUTZ Diesels, built in West Germany by the world's pioneer in internal combustion engines, are available in your area now. Send in the coupon for complete information.

DEUTZ

DIESEL ENERGY CORP.

82 BEAVER STREET, NEW YORK 4, N. Y.

Diesel Energy Corporation
Dept. C
82 Beaver St., New York 4, N. Y.

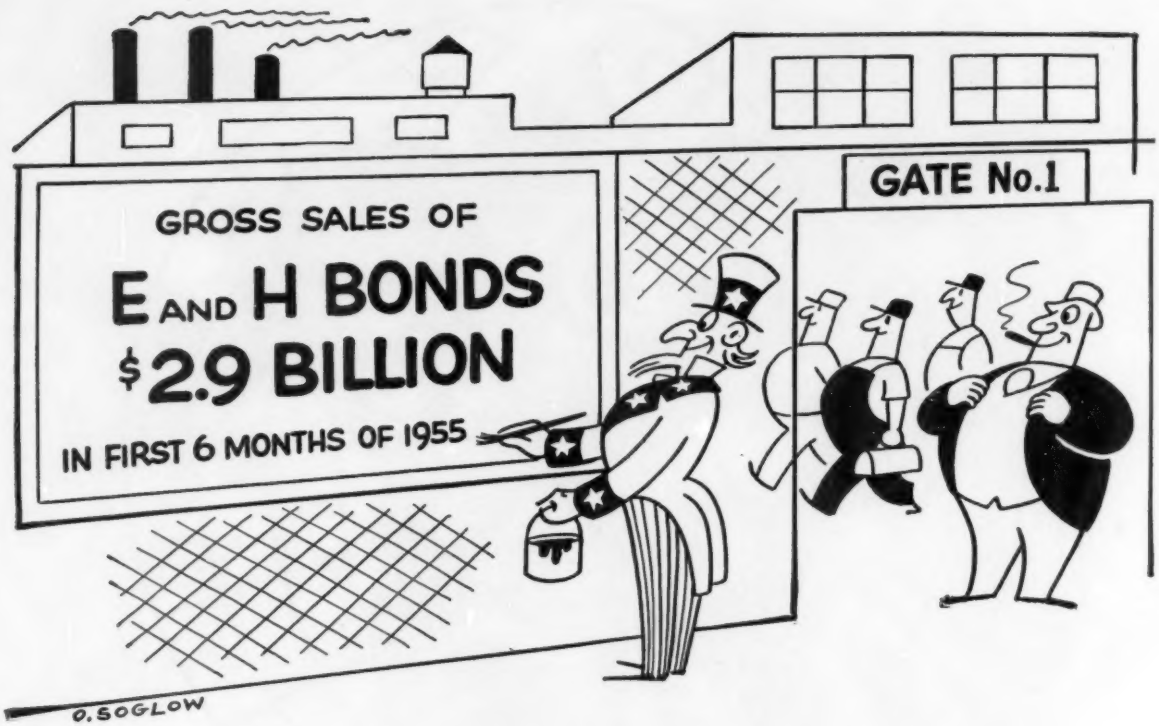
Please send complete information on DEUTZ Diesels. I am interested in ☐ Air Cooled ☐ Liquid Cooled Models of about _____ HP.

Name_____

Firm_____

Address_____

City_____ Zone____ State_____



If you are the man who is responsible for installing *and promoting* the Payroll Savings Plan in your company—

If you are one of the eight million Payroll Savers who buy Series E Bonds *every month* through the Payroll Savings Plan—

If you are one of the rapidly growing number of businessmen who are building for retirement through the consistent purchase of Series H (current income) Bonds—

You can well be proud of these figures:

- January to June '55 sales of E and H Bonds were the best in ten years—$2.9 Billion—a gain of 13% over 1954, 28% over 1953.
- Since January 1, *cash value* of E and H Bonds outstanding *increased over a Billion Dollars;* value, $39.3 Billion, *an all-time high.*
- Sales exceeded redemptions (matured and unmatured bonds) by $493,716,000.
- Current income H Bond sales averaged more than $100 million a month.
- January-June sales, E and H Bonds, represented 51.9% of the 1955, $5,500,000,000 Sales Goal.

What's good for America is good for business—*your business.* If your company does not have the Payroll Savings Plan . . . or if you have the Plan and employee participation is less than 50%, phone, wire or write today to Savings Bonds Division, U.S. Treasury Department, Washington, D.C. Your State Sales Director will contact you promptly. He will show you how easy it is to install the Payroll Savings Plan or boost participation over the 50% mark through a simple person-to-person canvass that will put a Payroll Savings Application Blank in the hands of every employee. That's all you have to do. Your personnel will do the rest.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

DIESEL POWER

Plain Facts...

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ORchard 3-8282

CABLE ADDRESS
DAROCOOK-SKOKIE

DAROS AMERICAN CORPORATION

D. D. COOK
President

8128 NORTH LAWNDALE AVENUE
SKOKIE, (CHICAGO SUBURB) ILL., U.S.A.

DEAR MR. ENGINE OPERATOR

The cost of fuel represents 50 to 65% of the total cost of your engine operation. Piston ring leakage increases fuel cost 10 to 15%. This WASTE is not necessary—

Renewal or reboring worn cylinders can be postponed thousands of operating hours. Sealing rings are available that stop all leakage in worn cylinders.

Operating time between ring renewals can be increased 100 to 500%, reducing your maintenance expense.

Cylinder and ring wear can be reduced 50 to 90%, depending upon your selection of piston rings made of wear resisting material.

Daros make piston rings designed to correct these conditions, using special material and design needed for each type ring.

CAN YOU AFFORD TO IGNORE THESE FACTS?—

ONE DAROS INSTALLATION WILL CONVINCE YOU

Very truly yours,

D. D. Cook

EXCLUSIVE WHOLESALE DISTRIBUTORS IN NORTH, CENTRAL AND SOUTH AMERICA
DaRoS PISTON RINGS — DaRoS METALLIC ROD PACKINGS — DaRoS CYLINDER LINERS
MADE OF WORLD-FAMOUS SWEDISH CHARCOAL IRON BY
AB. DAVY ROBERTSONS MASKINFABRIK, GOTHENBURG, SWEDEN
ORGANIZED 1851

(This is one ad in a series designed to tell Diesel Operators the important story about DaRoS Swedish Iron Piston Rings.)

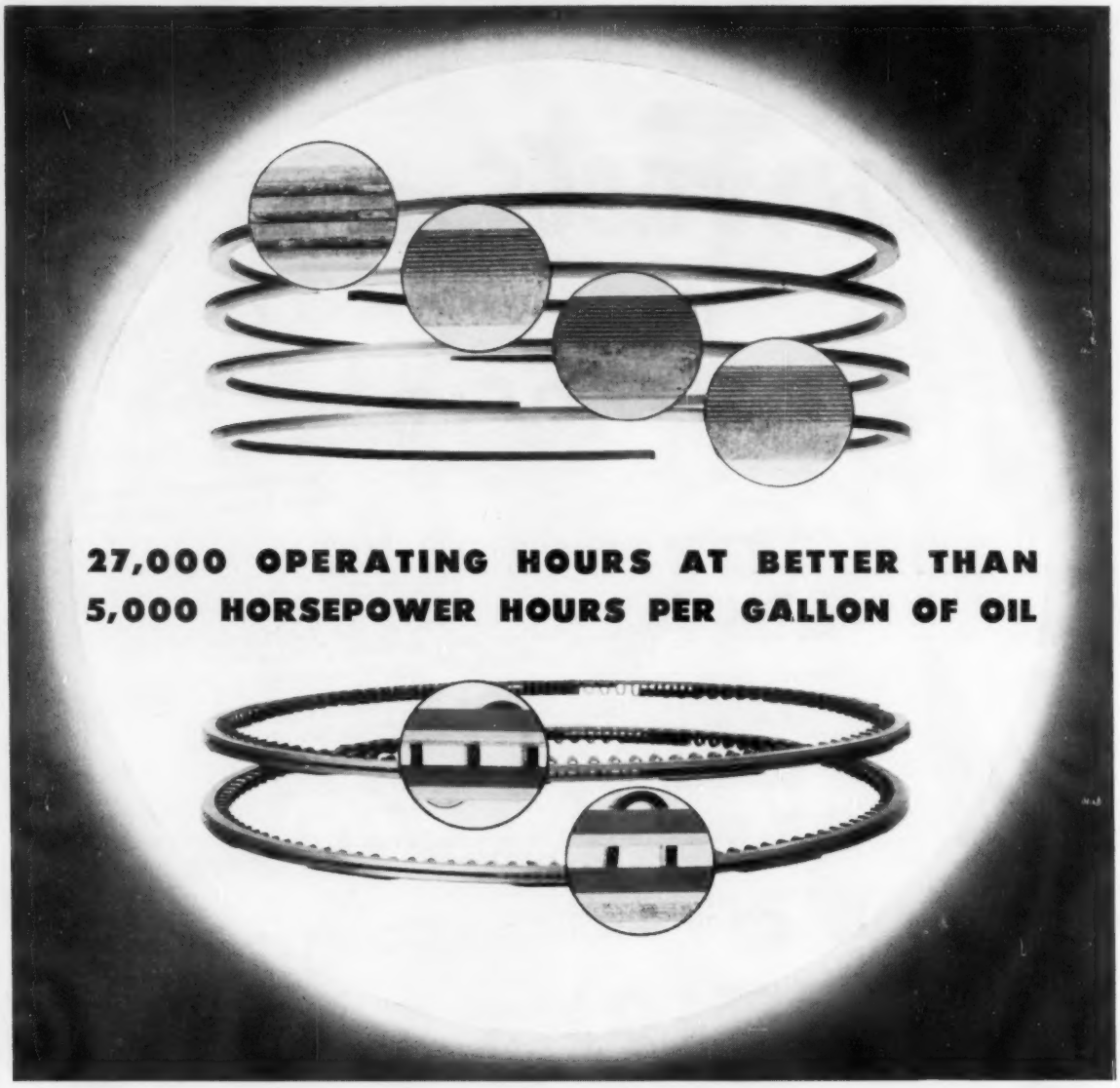
DaRoS American Corporation
8128 N. Lawndale Ave., Skokie, Illinois
Gentlemen: Send me complete information on DaRoS Rings.

NAME_____

FIRM NAME_____

STREET ADDRESS_____

CITY_____ STATE_____



27,000 OPERATING HOURS AT BETTER THAN 5,000 HORSEPOWER HOURS PER GALLON OF OIL

ENGINEERED RING SETS IS A PEDRICK FIRST

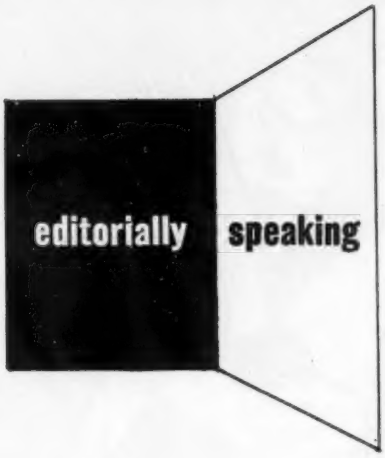
In 1921, the first complete set of rings in a single package, engineered for a particular internal-combustion engine, was introduced *by Pedrick*. You get 35 years of experience and know-how, therefore, in the complete sets we engineer for diesel and gas engines.

That's part of the reason Pedrick Engineered Sets give the kind of performance revealed by the un-retouched photo above. These rings are from a Pedrick E3902 Set taken out of a Cooper-Bessemer GMV engine after 27,109 hours of operation. Oil consumption averaged better than 5,000 hp. hrs. per gal. Wear in the cylinders was almost insignificant—averaging only .00725 in. at the top and .0035 in. at the bottom. Ring tension remains at practically original production level. Each ring shows face-wear only about halfway up, so rings still are practically as good as *new!*

For *your* engine's own good, use Pedrick Engineered Sets with the latest ring designs in proper combination, illustrated installation instructions, a single package per cylinder. You'll also enjoy the benefits of simplicity in ordering and stocking. The same engineering know-how which goes into Pedrick Engineered Sets is available to help you with special problems. Write, wire or phone: WILKENING MANUFACTURING CO., Philadelphia 42, Pa. SAratoga 9-3770. In Canada: Toronto 2.

Pedrick HEAT-SHAPED **PISTON RINGS**

PEDRICK PRECISIONEERING KEEPS PEDRICK FIRST



On Lube and Filter Problems

You're not with us, boys; some of you are not paying attention. We figured that by now our long-range program covering lubrication and its influencing factors had given most of the important answers to field problems. But data on filter and oil change practices collected for the report in this issue shows that there is a continuing need to get the straight dope right down to the fellow with a single diesel. You would think that with all the constructive information beamed at the user by ourselves, the engine builders, the filter makers, and the oil companies, that there would be no lack of authentic information. Take the oil companies. They have steadily improved oils and provided types suitable for even the most outrageous operating conditions. Lube oil selection has been simplified for high-speed engine usage by grouping oil types into the API Service Specifications. Field engineering, printed material, technical papers and articles, are some of the means used to spread information. Even their advertising shows their awareness of field problems. Note, for example, the increasing emphasis on on-the-spot lube oil evaluation—blotter tests, sampling services, etc. Yet our correspondent finds oil being dumped just because it darkens, and attempts to extend the oil's service life confined to just adding more or larger filters. Then the elements are often bought solely on "price". Those are some of the conditions as they exist: What are we going to do about it? Simply intensify efforts on all fronts. We're going to ask the engine builders, oil companies, filter makers, and other concerned, along with their own efforts, to supply us with more ammunition for a new campaign. And you fellows in the field with problems, pay attention.

BPE

Cyclan

RING IRON

retains true shape even after much deflection

- Combines the best characteristics of iron and steel.
- Equals or surpasses the wearing quality of cast iron.
- Approximates the strength of steel.
- Has extra high impact value for shock resistance.
- Stands up in super-charged engines.
- Can be readily chrome-plated.
- Functions efficiently without chrome plating.
- Has high resilience—excellent bearing characteristics.
- Now used for original equipment in heavy-duty engines.
- Now available for replacement use.

Cyclan is exclusively a Sealed Power development

Write for "The Cyclan Story"

Sealed Power

PISTON RINGS · PISTONS
CYLINDER SLEEVES

SEALED POWER
CORPORATION
MUSKEGON, MICH.

highlights

- A leading farm tractor manufacturer reports that in the Nebraska area, 60% to 70% of the wheel-type tractors sold during the past three to four years have been diesel powered.

- Yardney Electric Corp., New York, has developed a rechargeable storage battery that has a cell weighing only 1/6 oz. The 1/10-amp hr cell utilizes a new silver-zinc principle and is designed for applications needing high capacity and rechargeability in a limited space.

- Oil engineers have perfected a motor oil test that can be performed by the driver in minutes to determine need for oil change. Chemical color change on filter paper caused by oil blots indicates acidity or alkalinity degree. It also warns of cracked pistons, antifreeze leakage, and similar troubles.

- A $4,956,000 low-bid joint venture contract for construction of a 475-mi petroleum, oil and lubricant pipeline to serve U.S. air bases under construction in Spain has been awarded to Merritt-Chapman & Scott Corp., of New York; Benson and Montin, of Tulsa, Okla.; and Agroman Empresa Construction of Madrid. This will be another job for diesel-powered equipment.

- In Michigan, a cement company is making use of tube cleaners to locate underground pipe without digging it up. It just starts a tube cleaner in the pipe and follows the noise as it moves along.

- Pacific Mountain Express has designed a new piece of yard equipment, the Yard Doctor, to perform every possible job required in servicing a tractor. With it the mechanic can check and repair air and electrical systems, grease, check brake linings, inflate and change tires, pack wheels, and take on many other service functions usually done in the shop. For routine service checks, it's said to save at least 1 man-hr per tractor.

- The Spanish Air Base order has gone to Enterprise Engine & Machinery Co. It amounts to approximately $1.5 million.

- Virginian Railway Co. has ordered six 1600-hp all-purpose diesel-electrics from Fairbanks, Morse & Co. They'll bring the road's total diesel fleet to 50.

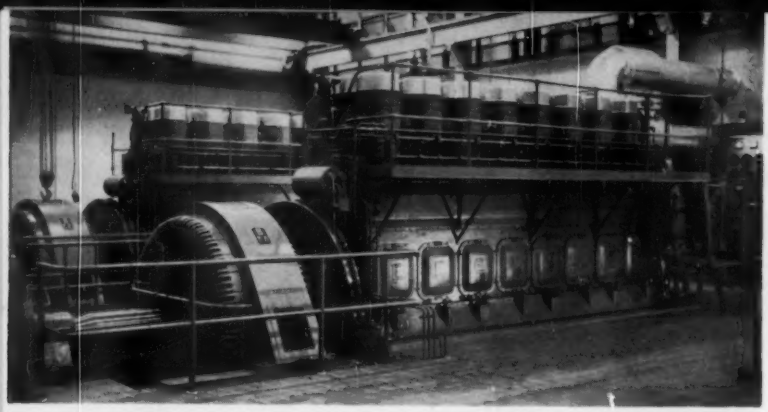
- Where do you put the drilling rigs? Shell Oil Co. solved the problem when oil men found a good spot to drill for oil under Lake Texoma on the Texas-Oklahoma border. The answer—on islands built of land dredged up from the lake bottom. As many as three wells can be drilled from one island. So far, 25 have been built.

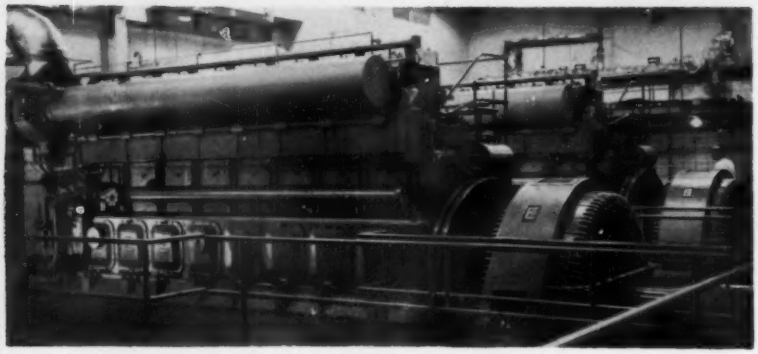
- The FPC has just released the 1955 issue of its map series showing principal electric utility generating stations and transmission lines in the U.S.

- A porcelain finish that looks like copper has been developed by Pemco Corp., Baltimore, Md. Maker says one firing of Coppertan finish applied to a steel surface gives a non-tarnishing and non-scratchable exterior.

- The City of San Francisco recently placed on order for 440 diesel-powered buses with Mack Trucks, Inc. The units will be made of lightweight material and powered by turbocharged diesels.

- A recent survey by the U.S. Bureau of the Census pointed out that state and local governments are planning 71,639 construction projects that come to a total of more than $25 million for the cost of construction. Approximately 43% of the projects reported were highway or street construction. These figures, coupled with some of the ARBA recently put out, stack up to more diesel-powered construction equipment, more servicing facilities and information and larger parts sales.





Two Model DQ-38 Enterprise 4-cycle, 8-cyl, turbocharged diesels furnish all power required by Tipp City.

Three Fuels at Tipp City

Efficient operation plus the use of three fuels on a seasonal basis gives Tipp City a low production cost.

EARLY this year, DIESEL POWER made a visit to Tipp City, Ohio. We were interested in the operation of this municipal power plant since it has a peculiar load condition and also operates on three fuels—residual fuel oil, gas, and No. 2 diesel fuel.

There were a number of questions that wanted answers. Our man for this was Mr. Russell Blank, Superintendent of Utilities for the Village of Tipp City.

Before going into the present operation however, we wanted a little of the history of municipal power at Tipp City since diesels were comparatively new to this plant. To say the least, municipal power here is nothing new. The first vote on the subject of a municipal power plant was back in 1895. Those were the days of the kerosene lamp and apparently no one seemed to know or trust this new-fangled electricity. The vote defeated the plant that year and also the following year.

In 1897, prior to the elections, a demonstration was held for the town with a steam engine driving a generator to light up about two blocks of the main street. This was the year the plant was voted in. Plant construction was completed in October of 1898.

This same thing has probably happened in other communities with some variation. At first, the plant was equipped with steam engines belted to generators and only supplied power for part of the day. Service was gradually improved and power furnished for greater portions of the day. The distribution system also grew to serve a greater area.

Turbines were the next big improvement. They took over from the steam engines and continued in operation for some time. Along about 1950, however, the plant was hard put to keep pace with the load demands placed on it by an ever-growing number of electrical conveniences. In fact, the firm capacity of the plant was approaching the danger point.

At this time, a thorough investigation was started to determine just what could be done to increase plant capacity. An expansion of the steam plant meant not only additional turbines but also another boiler. Diesels were suggested as was the use of purchased power from the local utility.

Diesels however, would need some investigation as they would be something completely new to Tipp City. Data on diesel operation, maintenance and costs was obtained mainly from visits to nearly every diesel-powered municipal plant within a 100-mi radius of Tipp City. Still more data was supplied by various diesel engine manufacturers. Consulting engineers were required so J. & G. Daverman of Grand Rapids, Michigan was called in.

When all angles had been considered and all the facts correlated, diesels seemed to be the answer. A closer look was necessary and besides, a few people had to be convinced that diesels would do the job. The study showed the diesel installation cost to be lower than the installation of the required steam equipment by about $200,000.

Specs were written and bids let for a diesel. Enterprise got the job, and the first diesel for Tipp City went on the line December 21, 1952. This was a Model DQ38, 4-cycle, 8-cyl turborcharged engine. It is rated 1755 hp or 1240 kw and has a bore and stroke of 16 in and 20 in respectively.

During the first few months of operation the diesel took over most of the plant load, and operating figures convinced the city fathers that steam equipment should be retired in favor of another diesel. A second engine

of the same make and model was installed in January, 1953.

Operation . . .

was the next thing we wanted to know about. Fuels were first—why three? The answer was simply a matter of economy. Gas is the cheapest when it is available but it is only available in Tipp City for part of the year. There is a one mill per kw-hr saving when operating on heavy fuel as compared to No. 2, but here again there are times when it is not readily available. When neither gas or heavy fuel is available, No. 2 is the cheapest available fuel.

Perhaps this would be a good point at which to take a look at some of the operating figures. Lube oil consumption averages out, over the 2-year period of January 1953 to December of 1954, to about 25,000 hp-hr per gal. Fuel consumption, expressed in kw-hr per gal has been in the order of 13.5 and 13.2 for light and heavy fuel respectively.

During 1953, both engines generated a total of 7,562,800 kw-hr. This figure was about 8% higher for 1954. The 2-year totals for hours of engine operation were 10,554 and 10,447 for engines 1 and 2 respectively.

Better fuel consumption figures would probably be shown if it were not for the peculiar load on the plant. This load situation is caused by an automatic welding machine at one of the industrial plants in Tipp City. Although the welding machine is equipped with 3-phase electronic rectification, it has been estimated that it causes a power surge of 750 to 850 kva every two or three seconds.

This means that when one engine is carrying approximately half load, the other half must be reserved to carry peaks caused by the welder. It also means that engines must be run at part loads much of the time and full fuel economy is not realized.

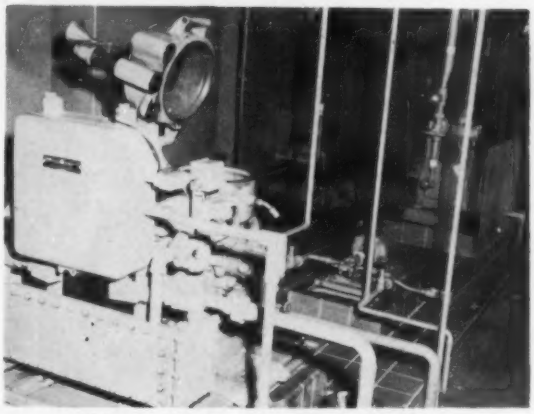
Another problem created by the fluctuating load is that engine speed variation and resultant frequency and voltage changes. In an effort to correct the latter conditions, Tipp City installed an electric governor developed by Westinghouse. This unit is connected to the generator output leads electrically and has the feature of sensing load changes before engine speed is affected, and immediately compensating for the change on the fuel rack.

At the time of our visit, the electric governor was still in the experimental stages and the installation was not quite complete, but early tests indicated that the use of the electrical governor greatly reduced engine speed fluctuation during load surges.

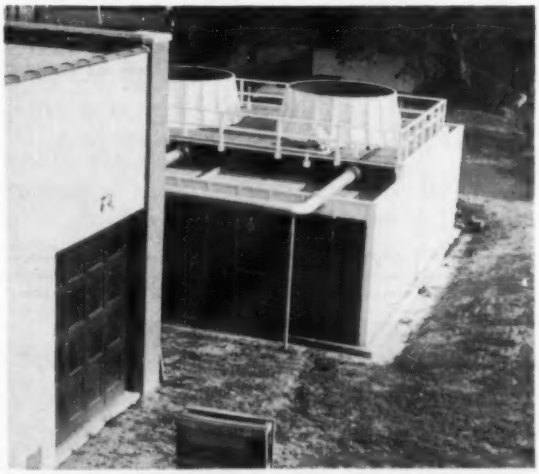
A Look at the Plant . . .

revealed a well-maintained installation. This was the impression we got from outside and the impression was strengthened when we walked in the door. The two Enterprise engines have been installed so as to allow adequate room for periodic servicing. Space has also

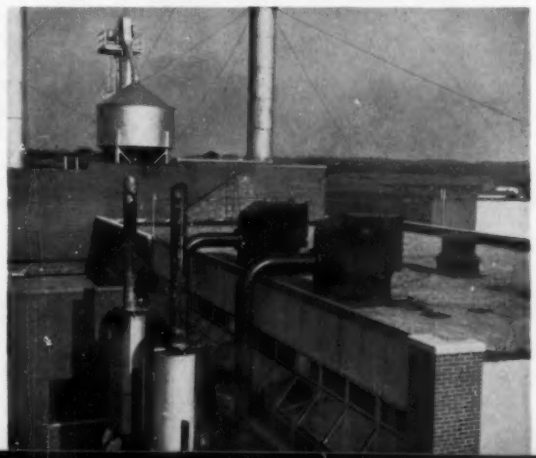
The well-kept exterior of Tipp City's plant indicates, in this case, a well-maintained plant both inside and out.

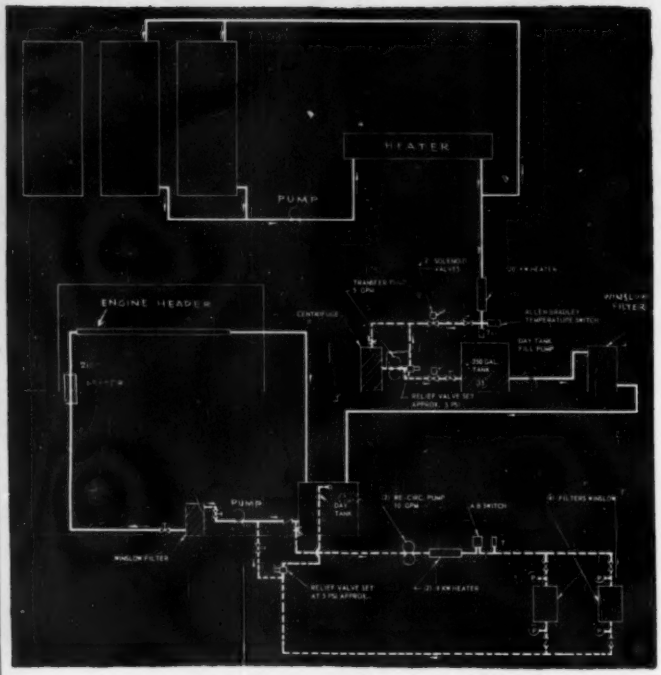


At one end of the engine room are the day tanks, lube oil centrifuge (shown) heavy fuel centrifuge and a brace of starting-air compressors —one motor-driven and one engine-driven.



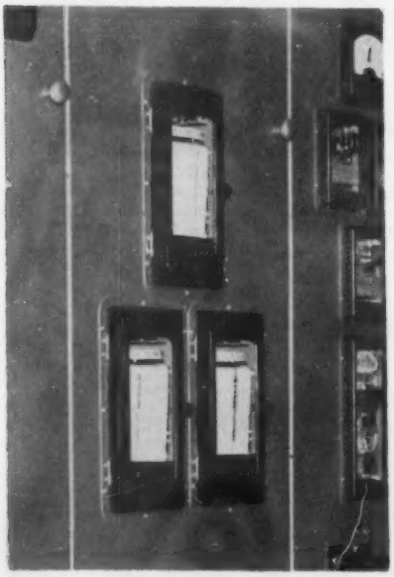
Standing on a catwalk near the top of the fuel oil storage tanks, we get a good view of the induced-draft cooling tower for the new engines (above) and also intake air cleaner and exhaust silencer location (below).





Heavy fuel piping diagrams showing arrangement used to keep fuel heated and moving. Fuel flowing through first heater is brought up to 145°F. Second (20-kw) heater boosts temperature to 200°F. Fuel in the day tank is held to between 180°F and 200°F and is constantly circulated through an 8-kw heater in series with parallel filters. A heater on the engine boosts fuel temperature to 210°F.

Effect of the plant's peculiar load can be seen best on the recording frequency meter (lower right). The time at which the welding machine was started can clearly be seen where it starts wider swing.



been allotted for the installation of a third engine.

For the most part, auxiliary equipment is grouped around the engine foundations in the plant basement. The exceptions to this arrangement are the starting-air compressors (one motor- and one engine-driven) and the lube and heavy fuel oil centrifuges.

As for the other equipment, it has been installed in accordance with general practice. The heavy fuel piping diagram will suffice to show this portion of what has been done. The list of principal equipment and the accompanying illustrations tell the unwritten part of the story. This leaves us but one category which has not been touched on.

Maintenance . . .

is a must in every installation. You have to live with an engine for a while to know at just how many hours a part or assembly must be serviced. Since diesels are new to Tipp City, and their diesel experience limited to the length of time they have had the diesels, manufacturer's recommendations as to operation and maintenance are being followed to the letter. Experience will dictate whether any minor adjustments in the maintenance schedule are required for this particular installation.

Steam plant personnel were trained in diesel operation when the first engine was installed. Training consisted of a 1-hr session two days a week for a period of eight weeks. This was in addition to what would be called on-the-job training, or actually working with the engine. Training must have been good and the men receptive because little beyond routine check up has been necessary. By the time major work is required both men and the engines will be seasoned veterans.

Principal Equipment

Engines	Enterprise Engine & Machinery Co.
Generators	The Elliott Co.
Governors	Woodward Governor Co.
	Westinghouse Electric Co.
Turbochargers	The Elliott Co.
Intake Filters	American Air Filter Co., Inc.
Exhaust Silencers	Maxim Silencer Co.
Cooling system	
Cooling tower	The Marley Co., Inc.
Heat exchangers	E. C. Cooley Co.
Pumps	Ingersoll-Rand Co.
Lube oil system	
Oil	Standard Oil Co. of Ohio
Filters	Winslow Engineering Co.
Centrifuge	DeLaval Separator Co.
Pumps	George D. Roper Corp.
Mechanical lubricators	Manzell Div., Houdaille-Hershey Corp.
Fuel system	
Fuel oil	Standard Oil Co. of Ohio
Filters	Winslow Engineering Co.
	Cuno Engineering Corp.
Centrifuge	The Sharples Corp.
Heat Exchanger	E. C. Cooley Co.
Switchgear	General Electric Co.
	Ideal Electric Mfg. Co.
Pyrometers	Illinois Testing Labs.
Starting air compressors	Quincy Compressor Co.
Thermostatic control valves	Powers Regulator Co.

GMC model 750 cab-over-engine tractor with sleeper cab that has traveled approximately 165 million miles since its diesel conversion in 1951.

Diesels Pay Off for McLean

by John Castle
Special Representative

Durable and efficient diesel equipment, employee teamwork, and a scientific approach to trucking pay off for largest motor freight carrier in South. Results—lower operating and maintenance costs, less downtime, and improved safety record, all with less driver fatigue.

JUDGING from the ultra-successful operation of the McLean Trucking Company of Winston-Salem, N. C., the necessary ingredients for a profitable diesel fleet operation are employee teamwork, a scientific approach to trucking, and good diesel equipment. All three factors have enabled the company to carry out its broad policy of providing shippers on the eastern seaboard with the best possible service.

They have also played key roles in making McLean the largest motor freight carrier headquartered in the South, and one of the top 10 carriers in the country. During 1954, the entire McLean organization, including its two wholly-owned subsidiaries and a trucking company which it operates and manages, enjoyed a whopping total operating revenue of $23,709,534.

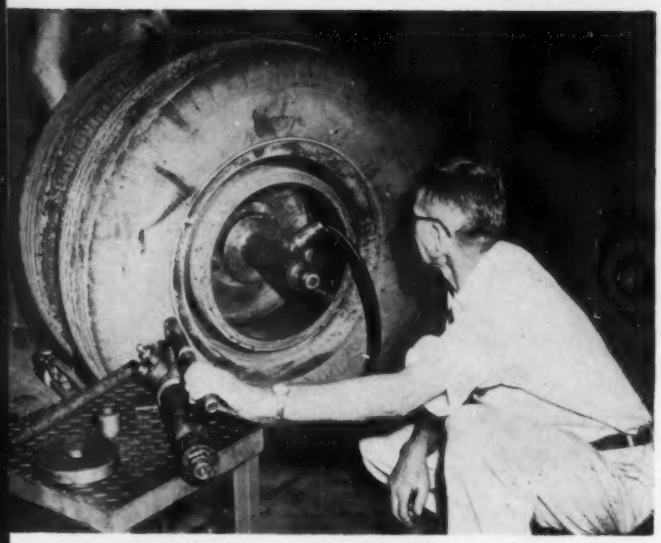
Giving credit where credit is due, McLean's president, Paul P. Davis, recently stated, "This word 'teamwork' may seem to be overworked at times, but teamwork has been the very essence of the growth and progress of our company over the years. Every member of the company . . . not just the officers and directors . . . make up our team . . . This company has prospered because every person in the organization has delivered the kind of service the shipping public needs and wants."

To provide this top service, McLean has set up an organization with experts in various fields lumped together.

Besides McLean itself, the organization consists of Modern Automotive Services, Inc., a wholly owned subsidiary that handles maintenance of the company's mobile equipment; Malja Corporation, another wholly owned subsidiary which takes care of real estate matters; and Carolina Motor Express Lines, Inc., that McLean has operated and managed under temporary authority of the ICC since February 18, 1952.

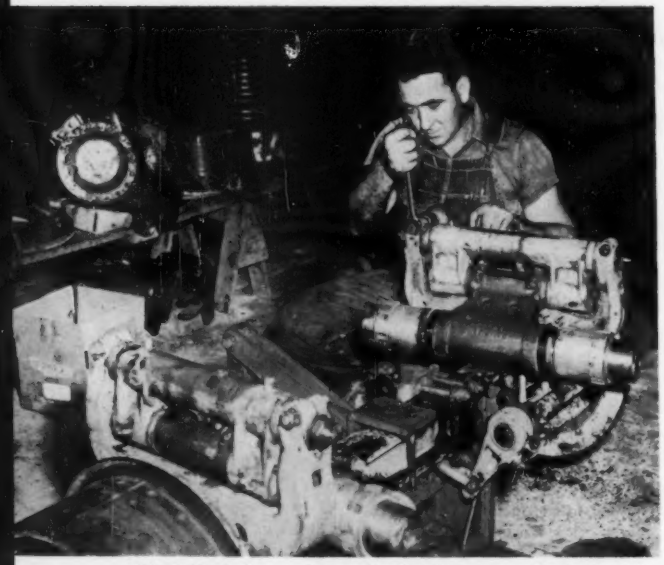
Although it might appear overly involved, the organizational setup is absolutely necessary to handle McLean's vast trucking area. McLean trucks serve the entire eastern seaboard between Atlanta, Ga. and Boston; while

Aerial view of McLean's headquarters shows terminal building, lower right, maintenance shops and administrative offices at upper left.



One device built and perfected by MAS personnel to increase maintenance efficiency, is the bearing cup remover and inserter shown.

C. E. Egger, V-P and General Manager of McLean's subsidiary, Modern Automotive Services, closely supervises all the diesel and mobile equipment maintenance.



The MAS employees also developed dolly for removing trailer axles. This method of switching axles effects a 25% saving in labor costs.

Carolina Motor Express Lines (CMX) vehicles connect the Midwest and the Southeast, with Chicago being the western-most terminal.

In 1954 alone, McLean and CMX tractor-trailer combinations traveled 48,758,960 intercity miles and the freight billed last year weighed nearly a billion and a half pounds. The company has more than 1700 units of mobile equipment and about 2400 employees. Although headquarters, central terminal, and main maintenance shops are located at Winston-Salem, McLean and CMX have a total of 41 additional terminals in the East and Midwest.

With such a huge freight-carrying operation, the types of over-the-road tractors are of vital importance. They must withstand hard usage and keep rolling. Since 1951, McLean has been using GMC tractors, powered with GM 4-71 diesel engines, in its entire over-the-road freight hauling operation. As of today, these tractors have traveled a total of some 165,000,000 miles and are still going strong.

Much credit for keeping this GMC fleet of more than 400 diesel-powered tractors in excellent condition must go to Cecil G. Egger, vice president and general manager of Modern Automotive Services, Inc. (MAS). Even though some of the oldest GMCs have as much as 600,000 miles of hard usage behind them, the availability factor for all tractors averages 97%. His organization also has been an important factor in keeping McLean's operating ratio at a good level.

On a calendar year basis, the ratio for McLean alone was 86.94 in 1951, 90.62 in 1952, 93.97 in 1953, and 92.88 in 1954. Even though the GMC trucks piled up hundreds of thousands of miles from 1951 through 1954, the operating ratio only rose slightly over that period and even dropped materially from 1953 to 1954.

Mr. Egger bases his maintenance program on preventing road failures. Here is one of the places where scientific truck operation plays a prominent part.

A complete history is kept on every truck. When new parts are added or repairs are necessary, these are noted on an index file card. This record-keeping not only gives MAS a good idea of the durability of the trucks, it also supplies it with information valuable in its preventive maintenance program.

From all these facts, maintenance schedules are worked out. For example, 67 component parts are checked every 15,000 miles both in the shop and on the chassis dynamometer located in the main maintenance grounds. Various parts are replaced at set mileages when performance

records show that they may be starting to wear out.

At present, the GM diesels get new rings at 100,000 miles and a complete overhaul every 200,000 miles. The latest improved components become a part of the overhauled engine, thus avoiding obsolescence of the basic design.

Under this program, MAS continually can upgrade its truck engines and get the maximum performance out of them. Commenting on one recent improvement, the high-valve injector, Mr. Egger pointed out, "Due to the high-valve injector, we've raised the injector replacement period from 15,000 miles to 60,000 miles, and it probably will go higher than that."

These improvements and the highly efficient preventive maintenance program at McLean's keep the rugged 4-cyl engine in the Models 650 and 750 GMC trucks functioning efficiently and economically. Downtime is very small.

MAS also devotes much of its time to cleaning the fleet and keeping it good-looking. Every time a tractor is washed, a special chemical is used to clean off the engine. Accumulated grease and dirt on exterior engine parts is virtually eliminated.

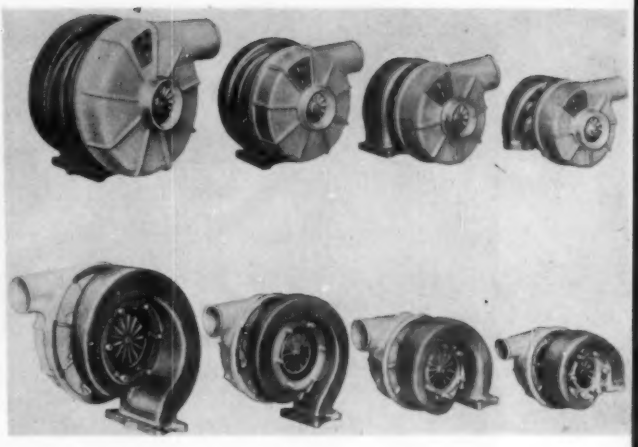
Over-the-road equipment is painted periodically in the shop's own paint shop. Besides the painting facilities, the maintenance area includes shops for reconditioning parts, recapping tires, and testing truck performance. MAS even has its own fuel testing laboratory.

Besides cutting downtime and providing trucks that will get the freight to its destination on time, the preventive maintenance program has contributed to McLean's excellent safety record and low claim percentage. Through April of this year, McLean's freight claim ratio was only 0.49% or less than one-half of one percent of net revenue. CMX, which leases trucks from McLean, has lowered its claim ratio from 0.97% in 1954 to 0.57% for the same period this year.

Safety-wise, the company has shown a marked improvement in miles per accident. For the first quarter this year, miles per accident were 188,215 compared with 136,595 for the same period in 1954. This low accident rate is also a result of McLean's continuous driver-training school which every driver must complete regardless of previous experience.

All of these programs are geared to the company's constant effort to give the best possible service to its customers. In an effort to speed shipments, for instance, McLean established the world's largest independently owned motor freight terminal at its Winston-Salem headquarters. It has 118 tracks where freight is loaded and dispatched promptly to its destination and is designed to move 3 million lb of freight every 24 hours.

A visitor to the McLean Trucking Company is impressed not only by the spic-and-span maintenance shops, the huge freight terminal, the shining tractors and trailers; he is also impressed by the hospitality of employees and the live-wire atmosphere of the offices. It's actually a team of persons working toward a common goal.



Schwitzer Turbochargers Cover Broad Range

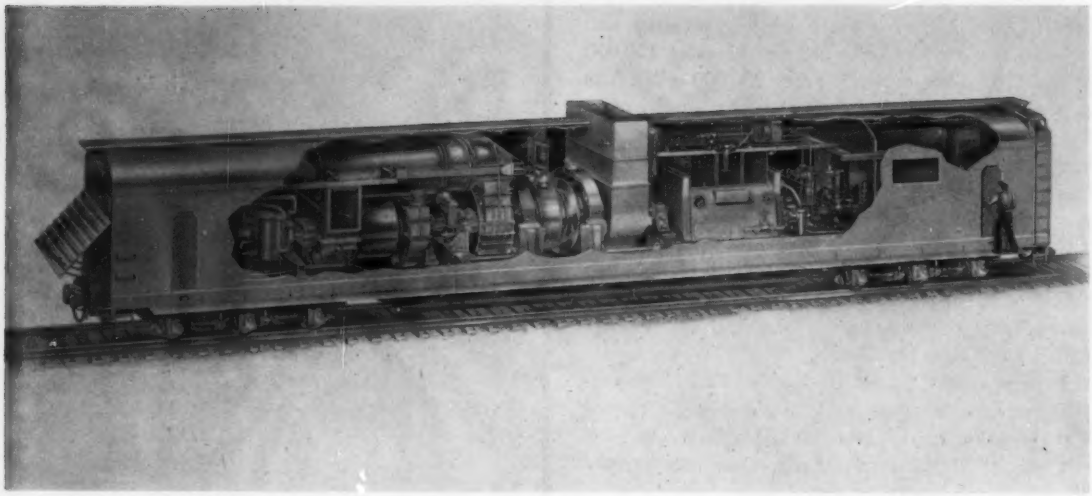
WITH more than 100 million ground miles of commercial operation with turbocharged engines chalked up Schwitzer-Cummins took another look at the turbocharger market. Forseeing increased turbocharger application due to demands for more and more horsepower in smaller packages, it standardized on one hasic design.

From this, four sizes that can be adapted to a wide variety of engines, without change in basic design, were developed. Cost would be a factor so complete production equipment including automated assembly and inspection departments and the latest type production test cells for the four sizes followed.

Applicational flexibility was gained by designing the four sizes with overlapping ranges, and further by the use of interchangeable stainless steel nozzle rings which can be varied to meet individual operating conditions. To put it in figures, the four different turbocharger sizes have been designed to cover engines in the 50- to 1200-bhp range, naturally aspirated.

As would be expected, construction of all four models is similar. The stellite turbine wheel is enclosed in an austenitic turbine housing and the precision-cast aluminum compressor wheel in an aluminum compressor housing.

Some of the advantages listed by the Schwitzer-Cummins Company include light weight; ease of installation; low cost; greater efficiency; and minimum maintenance. Facilities are also available for quick servicing and rebuilding of all Schwitzer turbo units.



Clark turbo-mobile power plant in specially designed railway car. Opening at left, is for air for lube oil coolers. Roof opening in center, is for turbine exhaust. Four main sections of roof can be opened or removed for unit maintenance or major overhaul.

Mobile 5500-KW Gas Turbine Package

Now a 5500-KW, 12,500-v, power package, self-contained in single railway car, moves to disaster area at up to 60-mph. Set up for operation within 24 hours, it requires outside connection only to a fuel source and transmission lines.

POWER enough for a small city has been packed into a single railway car. Development of a 5500-kw gas turbo-mobile power plant has been announced by Clark Bros. Co. of Olean, N. Y., one of the Dresser Industries. This plant was conceived by the U. S. Navy Bureau of Yards and Docks and designed and built by Clark Bros. The complete plant is mounted on a single railroad car, which can travel up to 60 mph, and be placed into full operation within 24 hours after arrival at the site.

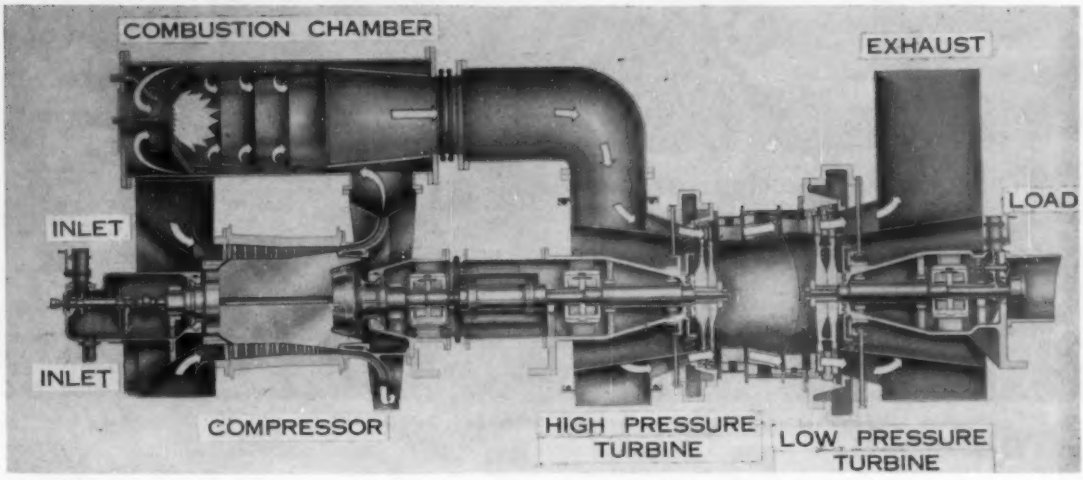
Application

The mobile gas turbine generator is designed for use in civilian emergency or wartime disaster. Natural disasters such as explosions, floods, tornadoes, hurricanes, earthquakes, drouts and fires cause power shortages which may affect entire communities or cities. Widespread power shortages, such as result from disabled municipal power plants, can be supplanted by this turbo-mobile unit, providing that transmission lines are intact or quickly repaired. Another use for this large packaged power unit, is for areas where population or industrial growth has exceeded existing power facilities. In this case, after permanent stationary plants are completed, the mobile unit is moved to another location where it is needed. Since this emergency unit is of the heavy duty type, it can be operated continuously for the duration of the emergency.

This 5500-kw power plant is rated at 80°F ambient, up to 1000-ft. altitude. The prime mover is an open-cycle, dual-shaft, series-flow gas turbine directly driving a 2-pole synchronous generator.

Constructional Features

The gas turbine consists of an axial-flow compressor and axial-flow turbine with two shafts. The first, or high-pressure turbine, consisting of two stages, drives the axial-flow compressor supplying combustion air, through a flexible coupling, at 5000 rpm. Combustion air is supplied by this 13-stage axial-flow compressor at a pressure ratio of 4.25 and a flow of 100 lb sec. The compressor case is split horizontally for accessibility. The second turbine, running independently, drives the load alternator directly through a flexible coupling at 3600 rpm. A direct-connected exciter is driven from the extension of the alternator shaft. This separate turbine design allows mounting of the two sub-assemblies on two separate sub-bases. Relative movement between the sub-bases, due to car deflections, is accommodated by a



Air enters 13-stage axial compressor, discharges into combustion chamber, mixes with fuel and burns. Hot gases enter high-pressure turbine, turning turbine and axial compressor. Hot gases then enter low-pressure turbine connected to load, and discharge through car roof.

flexible duct installed between the turbines. Removing this duct provides access to both turbines.

Combustion of fuel is accomplished in a single, contraflow combustion chamber. This chamber consists of two shells forming an inner combustion area and an outer annulus. Primary air flows through the outer annulus to the end of the chamber and enters the inner area where fuel is injected and burned. Secondary air passes from the outer annulus through openings into the inner chamber where it mixes with the products of combustion. The air flowing through the outer annulus also cools the inner walls to operating temperature.

Characteristics

The fuel system is designed to burn either liquid or gaseous fuels which may be simultaneously fired. Essentially, it is intended that the turbine burn gaseous or No. 2 diesel fuel to develop its rated capacity. However, after making certain adjustments to pressure regulators and valving, residual fuel oils can be used. When residual fuel oils are used, the turbine temperature is limited to 1150°F.

The turbine is designed for normal operation at an inlet temperature of 1350°F. Temperatures in excess of 1350°F may be maintained for varying percentages of operating time and are as follows: 1350°F for 100% of the time; 1375°F for 100% of the time; 1400°F for 25% of the time; 1425°F for 5% of the time; and 1450°F for 1% of the time.

The reason for limiting the turbine temperature to 1150°F, is to minimize the effects of vanadium attack, blade fouling from ash deposit and other faults arising from combustion of residual fuel oils. The expected maximum station output when operating with residual fuel, at this limiting turbine temperature, is 3200-kw.

When operating on gaseous fuel, and normal turbine inlet temperature, the performance characteristics of the machine at various load conditions, are as follows:

Loading	*Output Kw*	*Heat Rate*	*Efficiency*
Full Load	5500	18,000	19
¾ Load	4125	20,600	16.6
½ Load	2750	34,200	13.2

Operation and Control

In preparation for starting, at the site, the car brakes are set and wheels are blocked. In addition the filter sheds are opened, the turbine exhaust duct is opened and fuel and electrical connections are made. At start-up an auxiliary diesel engine is used to bring the turbine up to sustaining speed. This 6-cyl, 2-cycle diesel engine, rated 159 bhp at 1800 rpm, is connected to the extension shaft of the axial compressor through a torque converter and clutch. As soon as the compressor attains a high enough speed to furnish sufficient air for combustion, the diesel automatically disengages and the unit is self-sustaining.

The same engine also drives a 50-kva, 0.8 pf., 3 phase., 60-cycle, 480-v., alternator from the opposite end of the shaft. This alternator supplies all power for start-up, shut-down and cooling operations. Also, for all station lighting and other power requirements when the generator is not producing power. After turbine warm-up, the main generator is synchronized with the auxiliary generator which is then shut down.

The cross section shows the flow of air and gas through the turbines. The governor control system is of the pneumatic type, which regulates the alternator speed or frequency by regulation of fuel flow rate. High turbine inlet temperature, as well as rate of change of turbine temperature, are limited by over-rides interposed between the speed controller fuel throttle.

Normal shutdown is accomplished by reducing the turbine power setting gradually to idling and opening main circuit breaker. The main unit is stopped after the electrical load of the auxiliaries is taken over by the diesel-driven generator.

Artist's conception of the Rock Island's new Jet Rocket, being built by ACF Industries, Inc.

Lightweight Trains for American Railroads

Light-weight, high-speed passenger trains show promise of reducing operating and equipment costs plus attracting added passenger revenue through improved service and comfort.

BEFORE the end of 1955, a new concept in American rail transportation should make its debut on a regularly-scheduled run. This will be the Talgo-type train for the Rock Island. At least three other high-speed, light-weight low center-of-gravity trains will follow.

With the expected delivery of a new and much-improved Talgo-type train from A C F Industries, Inc., in December 1955, the Chicago, Rock Island & Pacific Railroad will place in service, what likely will be the first railroad owned, regularly scheduled, train of this type in America.

The Rock Island's train will be known as the *Jet Rocket*. It will make two round trips per day, between Chicago and Peoria, Illinois, (161 mi 1-way). It will replace on a speedier schedule, the present Peoria Rocket, the first of this road's diesel operated streamliners, inaugurated in 1937.

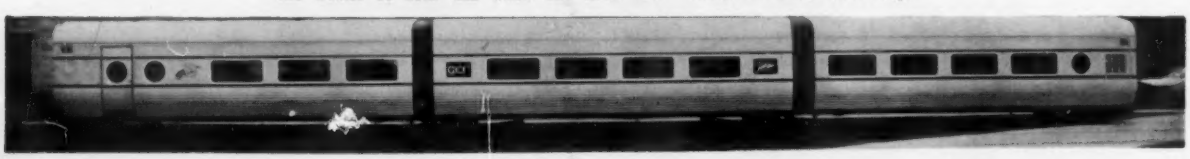
Jet Rocket Consist

A new light weight 1200-hp diesel-electric locomotive, identical to the one publicized for the new General Motors train will haul the Jet Rocket. It will be powered by an EMD 12-cyl Model 567-C engine. One standard 4-wheel traction motor truck in the lead, will furnish the tractive power. Head-end electrical power will be furnished by two 100-kw Detroit Diesel Series 6-110 engine-generator sets, located in the locomotive nose.

The train will consist of four, 3-unit articulated cars, each of which is completely reversible, as is the entire train. Automatic tight-lock couplers with centers 19-in above rails are used at the extreme ends of each 3-unit car. The three units of a car are not dis-assembled at articulated connections, which are ball and socket arrangements, except if the entire car is removed from service for necessary maintenance.

This four car Talgo-type train will have a seating capacity of over 300 passengers. Two 3-unit coaches will have full seating capacity of 96 persons each (32 in each unit) while one unit of another car will have a small baggage compartment and seats for 20, making a total seating capacity for that car. The other 3-unit car will provide 20 parlor car seats and 32 seats in a dining section, and a kitchen section in one unit. This is actually 296 revenue seats, with 32 additional dining section seats.

A coach for the Talgo train is made up of three articulated units. Center unit has wheels at each end while end units have wheels at outer ends only.



In General

Total length of the new American version Talgo 3-unit car is 109-ft 5½-in buffer to buffer, with a 10-ft 2-in width overall, and 10-ft 10-in height above rails. The objectionable overhang of a conventional car of this length and width on curves, is obviated by the three articulated units composing the car. The center unit is 36-ft 2½-in long, while the two end units are each 36-ft 7½-in long buffer to buffer. Floor height varies between 26-in and 28-in above rails, depending on load conditions.

The problem of access to or from high-level station platforms, seems to have been solved by the optional ACF "Hi-Lo" door, whereby retractable steps built into the car, permit passengers to step up to or down from high-level platforms. Only one step is required from the lower Talgo step down to ground platforms at top of rail height.

Interior car dimensions make possible roomette and bedroom sleeping accommodations, as well as parlor car and full coach seating of 84 to 96—varying according to arrangement and spacing, and space devoted to other services.

Each 3-unit car requires a maximum of about 40 kw, of 440-v, 3-phase, 60-cycle alternating current, for air conditioning, lighting, and heating. Two electro-mechanical, freon charged air conditioning packages, of approximately 5 tons each give a 10-ton cooling capacity per car. Each car has its own water supply tanks and distribution system.

Heating is provided by electrical fin heaters located in the air conditioning unit, plus a separate hot water heating system using an oil-fired heater, which circulates heated water through finned tubing in the side wall. A panel heating effect is used to distribute this heat uniformly throughout the wainscoting area. A trickle charger and batteries handle emergency heating and lighting in each car.

The center unit of the 3-unit integral car is supported by two pairs of wheels, one pair under each end. End units each are supported by one pair of wheels under each outer end, while the other end is carried by the center unit, through (ball and socket) connections.

Wheels support weight on internal roller bearings on a stub axle, one on each side. Axles are guided by mechanical means so as to be always radial to the rail. This results in the wheels rolling tangentially to the rail, even on curves.

Unlike the original Talgo this permits the car to operate equally well in either direction, with a minimum or perhaps no thrust against the rail or the wheel flange, eliminating the tendency of the wheel flange to climb the rail. Consequently, curves may be negotiated safely at speeds somewhat higher than with conventional equipment. A center of gravity at least 1½ ft lower than that of standard equipment also contributes to higher safe speeds around curves.

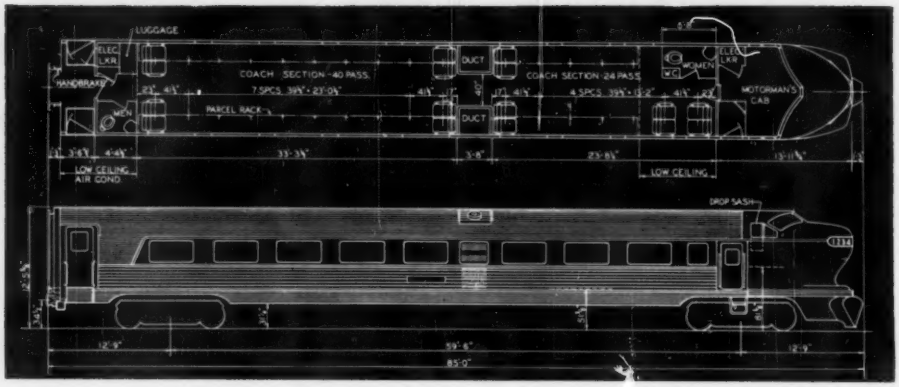
Brakes, operated exclusively by compressed air, are of the internal-expanding or automotive-type, with brake shoes inside a brake drum attached to wheel. Successful experience with this type of brake on the Spanish Talgos, leads to an estimate that average brake shoe life will exceed 500,000 mi on the new units. No hydraulic parts are used as on the prototype.

Designed to U. S. Standards

The new train has been designed specifically to meet all clearance requirements throughout the United States, and to satisfy American operational requirements. At the same time the basic Talgo advantages of light weight —low center-of-gravity, guided axles, complete reversibility and maximum flexibility, all have been retained. Many of these features are the result of six years and over 700,000 mi of operating experience with the Spanish Talgos.

The new design meets American strength require-

The new ACF Talgo, capable of taking curves at high speed, has been designed to meet the overall requirements of American Railroads.



The 6-car Budd train for the New Haven consists of six self-propelled diesel rail cars. The end units of this train have been modified and differ somewhat from the RDC units normally seen.

ments, including the full 800,000-lb buff load. Associated requirements for sides, ends and roofs have also been maintained. Underframes, sides and roofs are prefabricated, and then assembled in car form, which is an integrated tube like, skin-stressed structure.

Talgo cars may be built with an underframe of low alloy, high tensile steel. Superstructures may be of the same material or an aluminum alloy, with low alloy, or stainless steel for the exterior skin. Estimated light weights for a complete 3-unit car range from 65,000 to 80,000 lb, depending on the material used and type of interior accommodations. Coach weight per passenger is 700 to 800 lb. This is less than one-half that of comparable conventional cars.

Other Light-Weight Trains

A 5-car Talgo-type train is scheduled for delivery to the New Haven Railroad either later in 1955, or early in 1956. This train will run between Boston and New York on a fast schedule. It will be hauled by two 1700-hp Fairbanks-Morse diesel-electric locomotive units, one at each end of the train. These two units will operate in multiple, just as if they were coupled together at one end of the train. Such double-end operation requires control wires to be trainlined through all cars. However, the usual shifting of the train and locomotive to change the head end will be unnecessary.

Details concerning these new locomotives are not yet released. Undoubtedly both units will carry auxiliary diesel engine-generator sets to provide the 200 kw necessary to operate air conditioning, lighting, and a portion of the heating requirements.

An interesting feature of this diesel-electric locomotive, will be the method of providing tractive power to move train through the underground approaches into Grand Central Station, N.Y., as the diesel engines must be shut down before entering the underground. Will it be an arrangement to switch the traction motors over to take power from existing DC third rail current supply, instead of from the main generator on the locomotive—an arrangement which another road is studying for the North Jersey area?

Also scheduled for delivery to the New Haven in 1956 is a 6-car Budd RDC train. These are said to be the standard RDC units, modified to some extent, by removal of the engine cooling system radiators from the hump on top of the car to another location. This will reduce the height of car and lower the center-of-gravity a small amount.

These cars will have electric traction motors on idler axles for operation by third rail current while on underground tracks approaching Grand Central Station. Each end car will have a locomotive type cab from which the engineer can control all power plants—two 300-hp diesels under each car.

Two of the so-called Train "X" design, each consisting of nine light-weight, articulated, guided-axle, low center-of-gravity car units, are being built by Pullman-Standard Car Manufacturing Company. One of these trains was ordered by the New York Central System, and one by the New Haven Railroad. In each of nine car train, the center car is supported by two pairs of wheels, one under each end—like the center unit of the Talgo car.

Four single-axle car units are semi-permanently coupled to each end of the center car, and to each other riding "piggy back" through the connection to the wheel supported end of the car next to it. These eight units are described as four, two-unit cars, one of which is 51-ft 3-in and the other 48-ft in length. The longer units house entrance vestibule and toilet facilities. Each 48-ft car seats 48 passengers, except the center car (48-ft long) which seats only 40 because of wheel wells. Entrance cars seat 40. Air conditioning, brake, heating equipment and lockers take up space in one end of each car unit. Total seating capacity of the nine car assembly is 392 passengers, and over-all length of the train is 445-ft, without the locomotive.

Train "X" on the New Haven will be hauled between Boston and New York by two entirely new type Baldwin-Lima-Hamilton light-weight locomotive units, one at each end of the train. Each will be powered by one, 12-cyl diesel engine designed and built by Maybach-Motorenbau, of Friedrichshafen, Germany. This Maybach engine and its Medydro hydraulic transmission is to be

Artist's conception of the New York Central's Train "X" as compared to conventional train. Note difference in size of units.

mounted as an assembled unit on the one power truck located under the front end of locomotive. Power from the transmission output will be delivered to the four driving wheels through extension shafts and axle drive gears.

Auxiliary power for air conditioning, heating and lighting will be furnished on the New Haven units by a 6-cyl, vertical, in-line, Maybach engine, rated 465 hp at 1200 rpm and driving a 250-kw generator on each locomotive unit. On a similar B-L-H locomotive of one unit only, which is scheduled to haul the New York Central Train "X", the auxiliary head end power will be one Maybach 8-cyl, V-type engine, rated 570 hp at 1200 rpm, driving a 300-kw generator. These generators will furnish 440-v, 3-phase, 60-cycle, AC.

New Haven locomotive units will each be equipped with two 150-hp auxiliary electric motors, for operation through the underground approaches and into Grand Central Station in New York. These motors will be connected to axle drive units, and will operate on DC current from existing 3rd-rail installations.

A new "Tubular Train" for The Pennsylvania Railroad is being built by The Budd Company. Early in 1956 this train of "rail-hugging" two-level cars, with the lowest center-of-gravity ever engineered for railroad passenger cars, will go into service, between New York, Philadelphia and Pittsburgh, on daylight runs. It will be hauled by existing electric and diesel-electric locomotives. Faster schedules at safe speeds, increased passenger comforts, and sharply reduced construction, operating and maintenance costs are expected.

This train will consist of seven 85-ft coaches, riding on two, 4-wheel trucks, and a matching power car from which two Cummins diesels, driving 265-kw generators will furnish power for air conditioning, lighting and all-electric heating. Total seating capacity is 574. While these cars will be nearly 2-ft lower than conventional equipment, and have a 39-in center-of-gravity, coupler heights will be standard and so will the vestibule platform heights, thus no problems of access to or from high level station platforms.

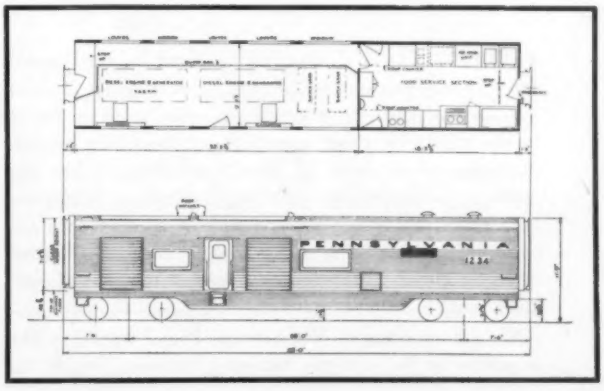
Still another light-weight, low-cost passenger train representing a "new concept" in railroad transportation is the General Motors train, designed to carry 400 passengers in "air-ride" comfort. The GM train was designed after a committee of railroad presidents asked car builders and locomotive manufacturers to come up with new ideas for passenger hauling equipment that would reduce equipment investment, reduce operating and maintenance costs, lower the center-of-gravity, increase average speed, improve riding comfort—and greatly reduce the railroads' passenger deficit, and sell for less than $1000 a seat when built in volume production.

This new train will consist of 10 coaches, each one carried on one pair of wheels under each end, riding on compressed air springs.

In addition to the general specifications set forth by the committee of railroad presidents, GM added another principle of its own—that existing proven components should be used in the new train wherever feasible.

Hence, the locomotive will be powered by an EMD 567-C diesel, with EMD generators, traction motors and control apparatus used on thousands of locomotives throughout the world. GMC Truck & Coach Division, car bodies adapted from their 40 passenger high-way coach with many of the air ride suspension parts interchangeable with standard GMC Sceni-Cruiser construction are integrated as are air conditioning from GM's Fridigaire Division; auxiliary engines for train heat, air conditioning, and lighting from Detroit Diesel Engine Division, and auxiliary generators from Delco Products Division.

This revolutionary train is designed for reaching speeds of over 100 mph for sustained stretches, and even though passengers will ride at a higher level than in other light weight trains, the center of gravity is 10-in lower than conventional cars.



An 8-car train for the Pennsylvania will be pulled by existing locomotives and will incorporate this power car.

A sample survey of the small trucker's practices in Changing Lube Oil and Filter Elements

Our correspondent has reported practices and problems as he found them in a survey of 14 truckers. Our experience bears out his main theme—there is confusion in the minds of many on this subject of change-out practices for lube oil and filter elements. We know industry has provided helpful information—we have published a lot of it. Since the data is still needed, we had better cover the ground again. In succeeding issues we plan to explore the problem from all angles. If you have questions in your mind, you can resolve them by following this series of articles.—Editor.

LUBRICANTS and maintaining them in good condition are two matters of vital concern in the internal combustion field. Yet there is probably more confusion in the minds of diesel operators on these two subjects than any other phase of diesel operation. Claims and counter-claims, mis-information, prejudice, buck-passing, incomprehensible data or lack of specific data and more particularly some of the recent "miracle" filter advertising claims, barrage the operator until he doesn't know what to believe.

We are speaking of Mr. Average Diesel Operator who is primarily in, say, the trucking business. He is the owner, business manager, perhaps one of the operators, and his business not being large enough to warrant a full-scale maintenance setup, his own maintenance superintendent as well. And though he might lack the necessary background, some of the decisions he will face are what oil to use, how long before draining, what type of filters to use, and at what intervals should they be serviced.

Engine builders specify the types of oil and the weights that should be used with different specifications fuels, particularly with respect to sulfur content. They specify average oil drain intervals but since they must prescribe without knowing the operational conditions they must be conservative. It follows that they must be equally conservative or even non-committal about servicing frequency for strainers and filters.

Oil companies are in the same boat. It is pretty obvious that they couldn't assign a lubrication engineer to each operation. Remember we are talking about the smaller diesel operators who buy pretty much at the local level and in relatively small quantities. They could probably get top echelon help if they asked for it but there are practical limits to this sort of thing. Not knowing the filtering system to be used, the operating conditions, engine conditions and quality of maintenance, oil companies can't make blanket predictions of oil service life or frequency of filter servicing except in the broadest and most conservative terms.

The stock answer by the engine builder, backed up by the oil companies, will be to follow their general recommendations. While this is probably valid, our trucker hears of someone getting double his oil service life; reads that if he uses the "XYZ" filter he never

needs to change oil; and if he puts in "Magic" additive, his engine worries are over.

Trucking is competitive and it is only natural to want to get the most for your money so our trucker wants to extend both oil life and the frequency of filter servicing. The question is where does he get unbiased information at a reasonable cost and in time to make a decision when a decision is needed most?

A survey of operators' oil and filter change practices, with interviews to find the "why's" and "wherefore's", was made. It produced some interesting facts, figures, opinions and delusions. In presenting this sample segment of the data obtained it is hoped that engine builders, oil producers and distributors, and filter suppliers will get a clearer picture of what the average trucker is up against. Then perhaps we can get some concerted action on ways and means to eliminate some of the current confusion.

Perhaps it will inspire some down-to-earth information to help these operators "out of the woods" and give them some food for thought about possible means of improving and/or economizing on oil, filter and engine maintenance. At the very least it will inform individual operators that they are not alone if they are in a state of confusion.

Making the Survey

A survey was conducted among 14 long-distance diesel truck operators, extracting considerable data on their lube oil, filter and engine maintenance. Their trucking operations center around a medium-small Southwestern city located on several major inter-regional highways. The city has little heavy industry; it functions as the hub of a vast remote agricultural, cattle and mining area.

The trucking industry flourishes on inbound manufactured goods and outbound ranch, range and mine products. State weight and length limits for vehicles in this region are the highest limits for vehicles in the nation and with the city 400 miles from the nearest supply center and market, diesels are almost standard equipment in the big rigs.

For a variety of reasons, certain automotive diesel makes are especially prominent in Western truck use. The survey includes data on only the two makes—one

Summary of Lube Oil and Filter Element Servicing Practices of 14 Diesel Truck Operators

Operator	No. of Trucks	Load	Engine Cycle	Cyls.	Displ.	Oil Change (Miles)	Filter Cart. Change (Miles)	Full-Flow Strainer Cleaning (Miles)
A	5	freight	4*	6	743	8000	4000	8000
B	15	cattle & freight	4	6	743	3200	6400	6400
C	4	cattle & freight	4	6	743	4000 to 7000	4000 to 7000	4000 to 7000
	2	cattle & freight	2	4	284	4000 to 7000	4000 to 7000	4000 to 7000
	1	cattle & freight	2	3	213	4000 to 7000	4000 to 7000	4000 to 7000
D	4	beverage	4	6	743	5000	2500	5000
E	26	cattle & freight	4	6	743	4800	4800	4800
F	4	cattle & freight	2	6	426	3000	6000	none
	3	cattle & freight	4	6	743	5000	5000	5000
G	4	cattle & freight	4	6	743	4000	4000	4000 screen-type 8000 bag-type
H	4	milk	2	4	284	2000 to 3000	2000 to 3000	
	1	milk	2	6	426	2000 to 3000	2000 to 3000	
I	1	freight	2	4	284	2000	2000	
J	7	freight	2	4	284	2000	2000	
K	1	freight	4	6	743	4000	4000	4000
L**	110	petroleum	4	6	743	when dirty	when dirty	2000 (approx)
	157	freight	4	6	743	7000 max.	7000 max.	
M	22	freight	2	4	284	10,000 to 12,000	20,000 to 24,000	
N	3	freight	2	6	426	10,000 to 15,000	10,000 to 15,000	

* Supercharged engines.

** Total fleet, relatively few visit shop which was surveyed.

2-cycle and one 4-cycle engine—most frequently seen in the region surveyed. Thus, the minimizing of basic variables results in sharper definition of the variations of factors under survey.

Information was obtained in the service shops and/or offices of the operators. It was gathered from personnel who either supervised or performed the lube oil and filter servicing operations. Accuracy of details, therefore, depends on their statements. Before getting into the survey details, a few comments on filters is advisable to avoid any misunderstanding in the interpretation of the results. Principally, it is essential that the terms "filter" and "strainer" be separated and explained.

Some diesels are furnished with full-flow screen or edge-type metallic strainers as standard equipment. Some strainers incorporate external handles by means of which the screen, discs, or spirally-wound ribbon elements may be cleaned during engine operation. Many of them must be disassembled for cleaning. Such devices will be referred to herein as strainers. While their function is limited to removing relatively large particles from the oil stream, the frequency of their servicing was one of the items investigated.

The term "filter" is reserved for units employing any of the numerous dense filtering media such as cotton, paper, wood and various exclusive substances. The elements take many forms including stacks of discs, pleated cylinders, cones, spirally-wrapped layers, plain cotton-filled sacks, cans jammed with wood chips and shredded paper, etc. Add to this complexity the different systems of filtration—bypass, shunt and full-flow—and you can see the buildup of a problem.

Evaluation of filter effectiveness is hard in the field. The time between cause and effect is generally too long when engine wear is the yardstick and even then all that you know is that one brand will or won't do a good job. Oil condition is a better and shorter-term indicator of filter effectiveness but engine condition enters into the findings too. Then there is the question of how to evaluate oil condition in the field.

Some filter builders have advised element changes when the oil darkens. This might be valid with some oils and with some filters but in these days of high-additive oils designed to keep harmless colloidal materials in suspension, it is a pretty unreliable criterion. There is talk that filters absorbent enough and dense enough to keep the oil color-clean will also remove the additives. True or not, there is a feeling that it makes little difference since lube oils in automotive service must be discarded before their additives will be exhausted.

Practically all diesel truck operators use lube oil filters in the belief that they are increasing the useful safe life of each fill by some unknown percentage. Despite their fundamental doubts about the value of visual cleanliness as a yardstick of oil condition, some operators install oversize filters and try all sorts of elements in their quest for longer operating periods with color-clean lubricants.

Getting back to the survey, it will be noted that names of truck operators and equipment are omitted. Names of operators, trucks and engines would contribute nothing, while oil and filter brands are frequently changed at some properties and any attempt to list them would involve chronic inaccuracy.

Survey Results

Lube Oils Used—All operators surveyed use popular Western brands, SAE 30 viscosity and in the MS or DG service classifications (corresponding to mil-0-2104A and Supplemental List 1 oils). One operator was experimenting with service DS (Supplemental List 2) oil for a small group of recently-delivered trucks with engines that seemed to "blacken" the oil very rapidly when using DG oils.

Of course the DS oil got black just as fast as the DG oil during the month's trial and no one had any definite idea as to how to judge success or failure of the experiment. While the DS oil *might* be more desirable and economically feasible in that case, its greater additive concentration did what it was supposed to do, and the rapid rate of discoloration threw this indication out as a valid yardstick.

Filters and Strainers—Most operators of 4-cycle engines use large bypass filters made by reputable suppliers. However, many of them use elements of various different makes in the same filter housing. Changes from one brand to another result from price, life tests (evaluated by color-cleanliness duration), elements offered gratis for trial, etc.

Direct contradictions were reported. Superlative performance was claimed for one element brand in a certain freight line with the same element called extremely inferior in another operation of almost identical nature. While three operators had distinct preference for the original element brand, three others claimed that it didn't compare with certain substitute elements (all different). At least three other operators admitted that they were unable to find enough difference in element life, oil condition, engine condition or any other factor to sway them against minor price concessions.

The 4-cycle engine involved in the survey is always supplied with a full-flow strainer of one of three types according to production date. Two have metal elements, one has a cloth bag, and all must be disassembled for servicing. It was found that all operators of these engines have a healthy awareness of this strainer and its influence upon oil pressure.

While some service schedules permit up to 8000 miles between service operations on this unit, it is the first thing inspected following reports of any lube oil system irregularities, or conditions related thereto. It seems probable that servicing would be more frequent if this strainer was mounted in a more accessible location.

The 2-cycle engine involved in the survey has no full-flow strainer but comes supplied with one or two bypass filters. The filters are physically smaller than those gen-

erally used on the 4-cycle engine (relative flow capacities and filtering areas are not known). For this reason plus an empirical assumption that 2-cycle engines are "rougher" on lube oils, some 2-cycle engine operators were found using additional lube oil filters.

Such added filtration had naturally been found beneficial. It should be noted, however, that some of the additional filters hold up to 14 to 18 quarts of oil. This automatically adds anywhere from 50 to 75% to the total lube system capacity. This provides better oil cooling, disperses the total contaminants through a greater volume of oil and so oil life and condition should naturally improve.

Lube And Filter Changes

The tabulation shown indicates that the most popular single combination is the practice of changing oil, filter elements and cleaning the strainer in the range of 4000 to 5000- mile intervals. Two operators on such a schedule were quite solidly convinced, upon the basis of much experience, that this is the simplest, cheapest and most desirable procedure.

Neither of them seemed interested in experimenting with longer intervals since the risk increases while the rate of potential savings drops. For one thing, the rate of oil consumption in many engines goes up as oil is kept in service longer, perhaps due to increased fuel dilution. However, these operators have had satisfactory engine life with complete lube system service at 4000-5000-mile intervals and none planned any change.

Some operators changed filter elements every two oil changes and others changed elements twice as often as the oil. Both procedures recall the phrase "mixing good eggs with bad" especially in consideration of the high percentage of total system oil held in the filter elements and in the housing. Origin and justification for such procedures were usually rather vague. Few operators appeared convinced of the merits of their procedure and three were frankly open to suggestion. They admitted that they didn't know what "should" be done but were reluctant to change because of fear of exploitation, and unwillingness to "buck" traditional company policy.

Operator "C" frankly admitted that lubrication services occurred when the trucks were available from their long runs on irregular schedules.

Operator "L" was contacted at an outpost shop, 400 miles from the firm's main shops where most servicing is done. However, the outpost shop also changes oil and elements in many trucks stopping at the local freight house if oil condition and/or mileage indicate that a change is due. Company policy calls for oil and element changes at 7000 miles but the outpost shop generally changes both *if the oil looks dirty and has been used* 1000-2000 *miles!* Full-flow strainers are cleaned once a week (which usually amounts to approximately 2000 miles) on all engines regardless of condition.

Operator "M" runs his 2-cycle engine for very high mileage between changes but the system was evolved through experience and engine service life is very satisfactory. Some of the engines enjoy color-clean oil for the entire 10,000 to 12,000-mile service period; others darken the oil rapidly but are serviced on the same schedule.

The service manager stated that one of these diesels had once operated 30,000 miles with color-clean oil but he preferred a more conservative schedule. These engines are fitted with large bypass filters but at present a substitute filter element is being used. They have found that an oil change without an element change revives color cleanliness for awhile. Furthermore, several capscrews must be removed to replace the element. As a result there is no great incentive to change oil and element each time. However, all free-flowing oil in the filter case is drained at the time of each oil change, even though the element is not removed.

Operator "N" is an independent owner with practically no facilities. He didn't know how much mileage was run between changes. His lube oil blackened very quickly so no color yardstick meant anything and he changes oil and elements together when he "thinks it needs it". This is generally at two to three- month intervals which he estimated to be equivalent to 10,000 to 15,000 miles. No engine records are kept. Significantly, he reports engine life as unsatisfactory.

In going over the tabular results of the survey it will be noted that the 2-cycle engines are serviced more frequently on the average, than are the 4-cycle engines. This can be partially attributed to the fact that the surveyed 2-cycle engines are 4-cyl units being used in a combination of highway and city transfer service. The latter service increases engine operating hours per mile and is less conducive to good oil and engine life than is steady highway operation.

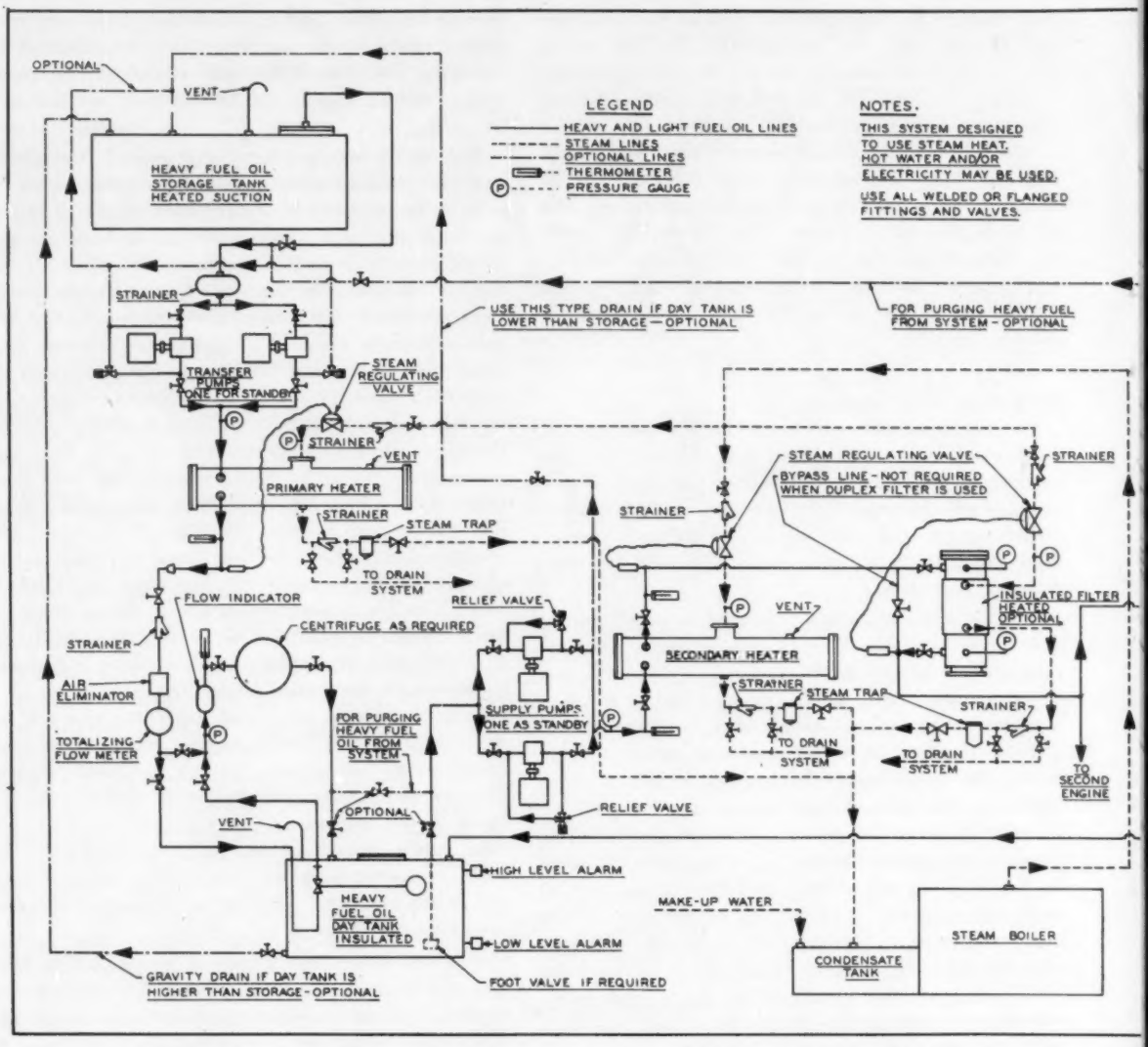
Also, crankcase capacity of this engine is little more than half that of the 4-cycle diesel. The psychological effect of half the "blow to the wallet" plus the feeling that 2-cycle engines were "tougher" on oil may well account for this tendency to "play it safe".

Conclusion

These facts have been reported substantially as found. This was the purpose of the survey. There have been no attempts to "play the expert" and offer solutions. There *are* solutions to this problem and it is hoped that this article will stimulate their appearance in published form.

Diesel engine sales depend very greatly on customer satisfaction. By and large, this means economy of operation or a job done better and faster which adds up to the same thing. It has been my experience that these conditions, as borne out by the survey, exist.

Since we know that there are answers to all these problems, it is to industry's interest to see that they get down to even the fellow with a single diesel rig. The need for the broadest possible dissemination of maintenance information is urgent. It is bound to pay off for all. This is a challenge to the diesel industry.



Schematic fuel system diagram proposed by DEMA committee studying burning of residual oils in diesels.

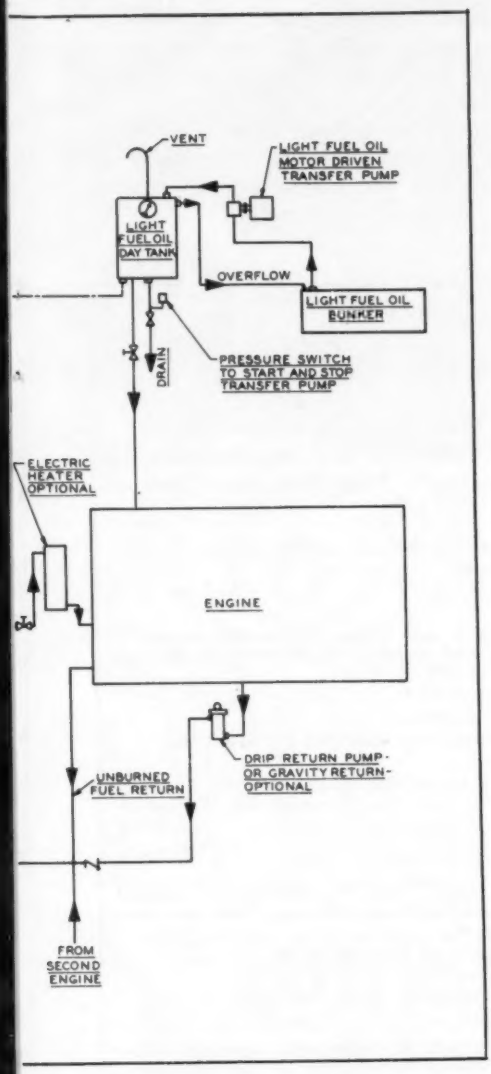
Preparing Residual Fuel Oils

An interim report reflecting the composite thinking of DEMA's member companies as applied to residual fuel preparation.

"STANDARD PRACTICES", published by the Diesel Engine Manufacturers Association is an industry standard as well as an applicational guide pertaining to low and medium-speed stationary diesel engines. Recognizing the economic pressures that are forcing a closer look at the possibilities of burning the cheaper, heavier fuels, DEMA organized a committee to study the subject.

One objective was to correlate the best thinking on this subject in order to prepare a chapter for the next revision of STANDARD PRACTICES. In context with the rest of the book and because of the nature of the problem, it would necessarily have to be in the form of a guide; there is no single answer to such a complex problem.

The cost, broadness of residual oil specifications, spotty patterns of availability, differences in engine design,



variance in operational conditions, etc., are only some of the factors that must be considered before reaching a decision as to burning of heavy fuels.

Residual oils, Nos. 5 and 6 or Bunker fuels are being burned successfully in many installations. The experience of the pioneering efforts plus the findings in the research labs of the various DEMA companies permitted a pattern for fuel processing to be evolved which, while not a pat solution in every case, is valid in the majority of cases.

This pattern as developed by the committee is reflected in the accompanying typical basic piping diagram and in the following comments based on their findings.

The system may be divided into two stages: (1) between the storage tank and day tank; and (2) between

Residual Fuel Data

API Gravity at 60°F

API gravity of a residual fuel may vary from as low as 3 or 4 to perhaps 14 or 15 for No. 6 fuel and from 13 or 14 to perhaps 19 or 20 for a No. 5 fuel. Gravity has little effect upon the oil as a fuel, but will indicate to some degree its general quality as well as its specific gravity. Fuels below 10 API gravity are heavier than water at 60°F and those above lighter than water. Gravity cannot be correlated with viscosity. It is desirable to select an oil that is lighter than water.

While it is desirable to use the lighter grades, it does not necessarily hold that a heavier grade would not make a good fuel. A low-gravity fuel of low viscosity could be a good fuel, providing its other attributes are satisfactory. As a general rule however, the heavier fuels are those that have been cracked down further, with the results that they are more viscous and have a greater concentration of dirt and a higher carbon content.

Viscosity

ASTM specification for fuel oils, D396, has established viscosity limitations for No. 6 fuels at from 45 to 300 SSF at 122°F and for No. 5 fuels at from 40 SSF at 122°F to 150 SSU at 100°F. When used for diesel fuel, the less viscous ones should be selected, if available, as lower temperature and less heat is required to bring them down to suitable operating viscosities.

Conradson Carbon

There is no established limit in a residual fuel for Conradson Carbon. The percentage in a fuel depends on several factors—the crude source, refining process, how far the residual has been cracked down, etc. Conradson Carbon percentage can vary from as low as 1 or 2% to 17 or 18% or even more. Conradson Carbon affects diesel operation very little in the lower concentrations. Higher concentrations may under some conditions cause a smoky exhaust. Specific fuel consumption may be affected where Conradson Carbon ratings are excessively high.

Sulfur

Sulfur in a fuel affects engine wear. It is well to select those fuels that have low sulfur contents. Much can be done, however, to combat the effects of sulfur by good operating practices. Sulfur in burning is changed to an oxide which in itself is quite free from corrosive effect. It is only when water is present that harmful, corrosive sulfuric or sulfurous acids are formed.

B S & W

According to ASTM D396 specification, water and sediment is limited to 2% with the amount of sediment by extraction not exceeding 0.05%. To establish any specified limits below this standard would mean premium fuel prices. In selecting fuels for diesel engine use, selection of those fuels that contain a minimum of B S & W will lighten the work of the centrifuges as well as reducing their maintenance.

Ash After Centrifuging

Ash percentage after centrifuging is a figure subject to wide variation. After centrifuging, the remaining ash is, if centrifuging has been efficient, soluble ash and little can be done economically to reduce it. It is reasonable to expect an ash content in the fuel after centrifuging of from 0.01 to 0.05%.

Flash

Flash point needs little discussion because it is generally established by law at some minimum. ASTM minimum is 150°F but residuals seldom run this low.

Vanadium and Vanadium Pentoxide

These materials appear in most residuals to a greater or lesser extent. Vanadium of 70 PPM or vanadium pentoxide of 125 PPM should be considered the maximum. In choosing fuels for diesels, those containing minimum amounts of each should be selected.

the day tank and engine. Each stage will be discussed. Although steam heat generated by an oil-fired boiler is shown for heating the oil, electricity may be employed or if the oil is not too viscous, hot water from the engine jackets may be utilized. In any event it is advisable to use thermostatically-controlled heat to prevent viscosity fluctuation.

A heated suction for the storage tank is generally advisable in areas where ambient temperature is such that a viscosity between 2000 and 5000 SSU cannot be maintained. Heat may be in the form of low pressure steam or hot water, but precautions should be taken to prevent any leaks in the heating system inside the tank.

A fuel transfer pump operating continuously, with a spare unit as standby, discharges oil through the primary heater, centrifuge and to the day tank. Heating the day tank is not necessary if it is insulated. Centrifuging temperature is maintained such that the viscosity range is 100 to 250 SSU for best results. Day tank level is controlled by float-actuated valve which permits the centrifuge to purify only the amount of oil the engine consumes. Centrifuging at such a slow rate increases the cleaning efficiency. The centrifuge is shut down for cleaning as required, and as added protection, a standby centrifuge may be used if the expense is warranted.

In the system's second stage the oil is heated and filtered. A standby supply pump is recommended. The supply pump discharges through the secondary heater, filter, electric heater, and then to the engine.

Temperature of oil from the secondary heater should hold viscosity in the range of 50 to 150 SSU for proper operation of injection equipment. An insulated filter is necessary and although provision for heating is optional it has been found advantageous when first placing the system in operation or after shutdowns. The electric heater is also optional and may be dispensed with if the filter is heated.

Provisions are shown for draining the heavy fuel oil day tank and purging the complete heavy fuel oil system with light oil, by using only existing equipment. This is advantageous if the heavy oil system is shut down for any length of time as heavy oil will congeal, causing considerable damage and expense.

Sizes of the various pumps, heaters, centrifuges, filters, etc., will depend on the amount of heat available, specifications of residual oil being used and amount consumed. Available specifications of the residual oil proposed should be submitted to the engine builder who will make recommendations as to suitability and proper cleaning means.

Specifications for No. 6 fuel ordinarily include only API gravity, viscosity, BS and W, and flash. No. 5 fuel specifications include ash as well. The full list of data given is all desirable information if it can be obtained. Remember that residual fuels, selling for less than crude oil, can only do so because of the broad ASTM specifications. Attempt to impose further specifications may lead to increased cost.

The engine should always be started and stopped on light oil. Before shutting down, the unit should operate on light oil until all the heavy oil in the piping on the engine has been consumed.

Although the diagram is based on a one-engine installation, it is possible to serve additional units by use of pressure regulating valves to maintain a constant pressure in the heavy oil supply header.

What Do You Know!

Here are some questions to test your general knowledge of the diesel field. Make your selections, then turn to Page 78 to check them.

1. Blackening of the lubrication oil indicates that it is no longer fit for use.
   a. True b. False

2. In comparing 2- and 4-cycle engines with respect to the effect of each on lubricating oil, would you say that 2-cycle engines were
   a. Harder on oils?
   b. Easier on oils?
   c. Harder or easier depending on design, etc.?

3. Addition of a second filter on an automotive diesel will automatically increase the oil's service life in terms of hp-hr per qt. or gal.
   a True b. False

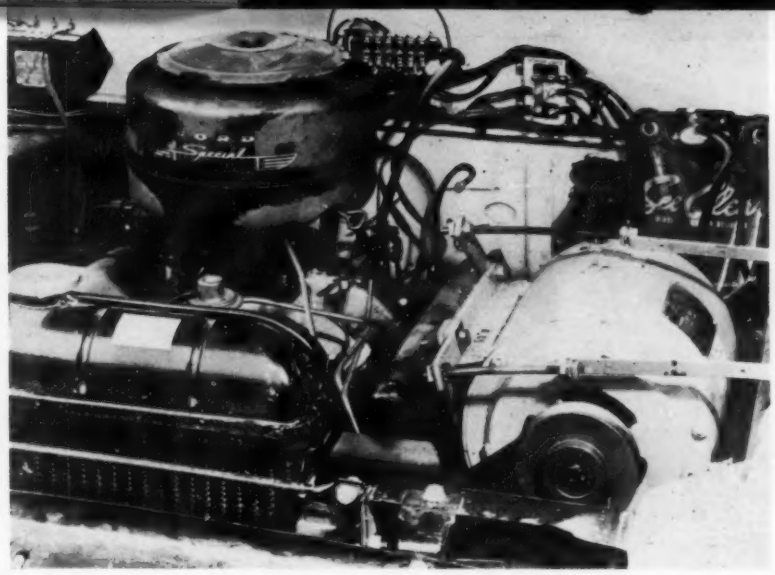
4. In alternator design, either the fields or the armature can be the rotating element. Rotating field units have the advantage of
   a. Eliminating slip rings and brushes
   b. Permitting higher rotational speeds
   c. Rapid buildup to maximum voltage

5. Sulfur in fuels and the oxides they form after combustion are harmless in themselves but become harmful when water is present. By keeping water out of the fuel supply, sulfur troubles can be eliminated.
   a True b. False

6. The ASTM D 396 specification for Nos. 5 and 6 residual fuel oils limits three qualities for No. 6 and four for No. 5. Select these from the items below.
   a. API gravity
   b. Viscosity
   c. Conradson Carbon
   d. Sulfur
   e. BS & W
   f. Ash after centrifuging
   g. Flash
   h. Vanadium and vanadium pentoxide

7. The lighter the grade of fuel, the more desirable it is for use in diesel engines when economy is not a major factor.
   a True b. False

8. Chemically treating water so that all hardness is removed prevents cooling system corrosion.
   a True b. False



Alternator even fits easily under crowded hood of passenger car. Regulator can be mounted anywhere, it needs only to be electrically connected to alternator.

10 KW from Under the Hood

An alternator small enough for under-hood mounting makes available a 110/120-volt outlet wherever your vehicle goes.

HOW many times have you driven to a job beyond reach of convenient outlets? Naturally, standard AC electrically operated shop tools could not be used. Hours of hand labor followed, raising the overall costs. You can now kiss this frustrating situation good-bye.

The use of standard shop tools has been extended to any location where your vehicle can travel. This is made possible by the use of a new 10-kw, 110/220-v alternator. This compact, lightweight unit was designed by The Star-Kimble Co., Motor Division, to be mounted under the hood of your service truck or any other vehicle. The "MO-BIL-AC", as it is called, is driven by a vee-belt from a sheave on the crankshaft in front of the fan pulley, or by a power take-off. Electrical equipment which requires alternating current at commercial voltages and frequencies, single or poly-phase, can now be powered by this unit. Some of the tools operated by the "MO-BIL-AC" are drills, saws, grinders, sanders, and soldering irons. Power for small pumps, hoists, welders, air compressors, two-way radios, telephones, fluorescent lighting for buses, etc., can also be furnished.

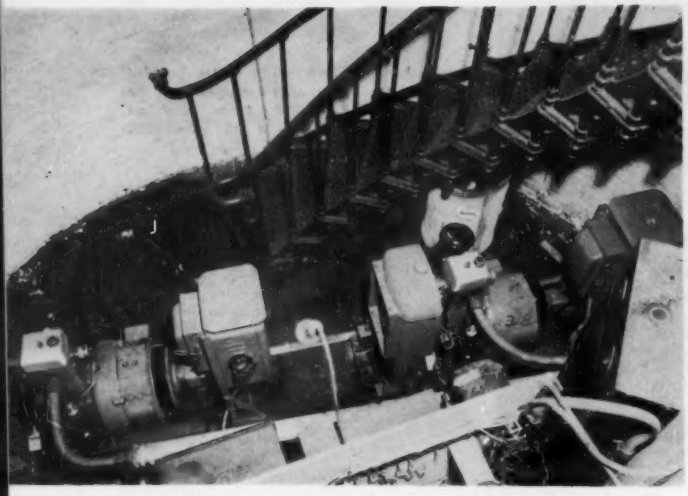
To keep down size and weight, excitation is provided by rectifying a part of the 2-pole alternator output instead of using a rotating exciter. This excitation is furnished by a regulator, a static unit of the magnetic amplifier type with a selenium rectifier. Its operating characteristics closely match those of the alternator and has encapsulated windings for protection against moisture and vibration.

Regulation is close and transient response of the system is such that when full load is applied, voltage recovers to full setting in one second or less. Since output voltage is proportional to output frequency, close frequency regulation is not a critical requirement. This makes possible operation of standard motors over a wide range of frequency without overheating. However, their speed and horsepower will be proportionately reduced if the alternator is operated below rated speed.

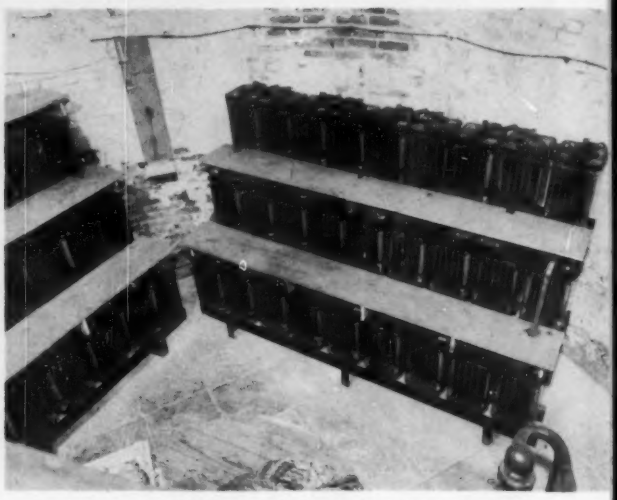
The modern trend is toward more extensive use of AC auxiliary power in vehicles where the power requirements exceed those of normal battery charging. When the need for additional power arises, availability of 110/120-AC generating systems permit the use of commercial standard electrical equipment, eliminating need for buying expensive special voltage equipment. Also, favorable features of the AC system can be realized. These include compactness, low initial cost, long life, low cost of servicing and repair.

With rotating-field-type alternators, rotational speed is limited only by ball bearings. The alternator can be made to turn faster at lower engine idling speeds with no ill effects. This results in reaching maximum alternator voltage sooner. Obtaining maximum voltage at lower speeds, permits operating tools while engine idles.

The many benefits of AC generating systems, coupled with the fact that units with other ratings can be designed, satisfies numerous applications other than those listed above.



End-to-end mounted Fairbanks-Morse Model 45B3-⅛ automatic generator sets with control panels, relay board, and switchboard.



The 54 Exide storage batteries are kept fully charged by the F-M diesel and inspected monthly by the U.S.C.G.

Diesels now "Keepers of the Light"

Running unattended between monthly Coast Guard visits, two 3¼-KW Fairbanks-Morse diesels provide reliability and lower operating costs.

UNATTENDED engine installations, particularly in isolated areas, are becoming more and more common in this age of precision machinery and "intelligent" electrical control systems. Since the Coast Guard took over the Lighthouse Service in 1939, the full burden of manpower has fallen upon its shoulders. Before Sand Island Light was converted to a self-operating station in 1948, three Coast Guardsmen were quartered on the island at all times. Now, two Model 45B3⅛ Fairbanks, Morse diesels are "keepers of the light".

An important consideration in converting the lighthouse was the age of the structure. The original Sand Island Light was constructed in 1838, almost 120 years ago. The existing structure was built in 1873.

In 82 years of service, both the lighthouse and its foundation have become progressively weaker. The untreated piles are sunk in sand and continued erosion has deepened the channel. The only access to the island at the present time is by motorwhale boat. All supplies, including drums of fuel, have to be carried over the granite blocks coolie fashion.

These conditions, plus the manpower and supply problem, helped speed the Coast Guard's decision to convert the lighthouse to a self-operating station. Sand Island's 30,000 candle-power light, which can be seen at sea for a distance of 17-mi under normal conditions, is the first light seamen see as they approach the coast. It not only marks the harbor's main ship channel but warns ships away from dangerous shoal waters. Under no circumstances could it be abandoned.

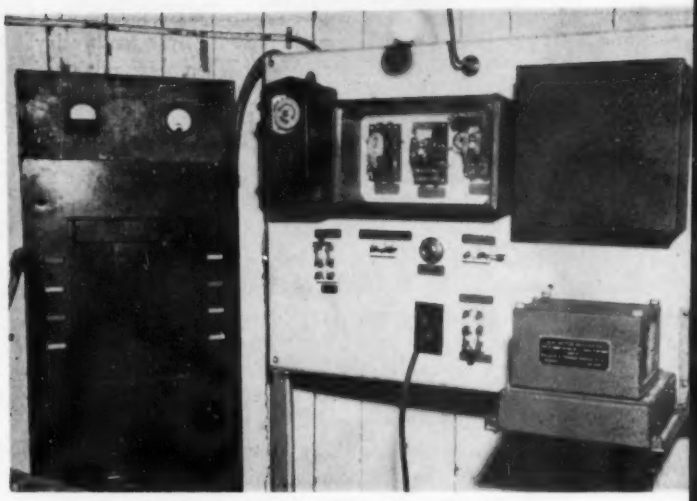
The answer seemed to be to install modern generating equipment, dependable enough to operate over long periods of time without supervision and without danger of breakdown, and to devise an electrical control system to operate this equipment.

Installation Problems Solved

In completing the conversion, the Coast Guard was faced with and solved successfully a number of related problems. The first was the electrical control system itself. This was solved earlier, when two gasoline engines were installed and needed no significant adjustment later. The second was the problem of ventilation. This was almost completely solved when the gasoline engines, with their volatile fumes, were replaced with diesel engines. But fumes from the station's 54 storage batteries continued to collect in the locked lighthouse. In addition there was danger that, without proper air circulation, the engines would tend to overheat.

Another problem was replacement of the lighthouse's 1000-watt incandescent lamp when it burned out. It would be highly impractical to dispatch a boat and crew from the Coast Guard base at Mobile every time this happened. Still another problem was transportation of

The Wallace & Tiernan automatic lamp changer solves the problem of changing burned bulbs in unattended lighthouse.



Shown are the switchboard and relay board with time switch, sequence, starting, and field relays and dual-motor flasher.

the two diesel engines out to the island in a motor whaleboat and then over the granite blocks.

This last problem was possibly the easiest to solve. The two diesels, still in their original crates, were carried out to the island in a 40-ft Coast Guard utility boat. A motor-powered boom lowered each engine to a barge, where they were firmly lashed and secured. The barge was then towed to the island by a motor whaleboat and moored to one of the granite blocks. The crew at this point took over with muscle power.

Skids were laid over the granite blocks at the most convenient point and the Coast Guardsmen dragged each engine up the ramp and into the ground-level engine room of the lighthouse. No trouble was encountered.

The two Model 45B 3⅛ E14 F-M units, have single cylinders of 3⅛-in bore and 4-in stroke. They are rated at 5¼ hp each at 1800 rpm and drive 3½-kw, 125-v 31.7-amp DC generators. The drive is direct, through flexible, disc-type couplings.

Controls

The control system devised to start and stop the two Fairbanks-Morse diesel engines, and also to protect them while running, is necessarily a complex one. It includes ten relays, nine of which are arranged in series with the central control relay, which automatically shuts the engines down by cutting off the fuel supply.

On its appointed night, each engine runs 10 to 12 hours, until batteries are fully charged, and then automatically shuts down. The other engine, meanwhile, acts as a standby, ready to pick up the load in an emergency.

In brief, the system is as follows. A half hour before sunset, an astronomical clock, which automatically compensates for changes in solar time, actuates a time switch, which in turn throws the main light on and opens a tuned voltage relay (TVR). This relay energizes the electric starter on one of the two diesels, placing the unit on the line. The following morning, ½-hr after sunrise, the time switch shuts the main light off and actuates a sequence relay, which permits the No. 2 diesel to start that night.

The field relay, which is also closed at a half hour after sunrise by the time switch, increases the charging rate of No. 1 diesel. This in turn brings battery voltage up to whatever voltage the TVR has been set for, usually 125 v. When this voltage is reached the TVR actuates the control relay, cutting off fuel and stopping engine.

When an engine is shut down, a reverse current relay opens the charging circuit, thus preventing current from flowing back to the generator from the batteries. To prevent a full load from being placed on a cold engine, an Agastat relay has been installed. This relay maintains a high resistance in the field circuit for a 4-min period after each engine has been started, permitting the generator to get up to normal operating temperature before it begins to carry a full load. At the end of four minutes, the Agastat relay decreases the field resistance and closes the charging circuit.

If one of the two diesels should fail to start for any reason within a predetermined period of time, it is automatically shut down by an overcranking relay, which is in series with the control relay. The second engine is then put on the line as a standby. An overspeed relay protects each engine against excessive speed, while an overcurrent relay is acutated when the generator output exceeds the overspeed relay setting.

This is accomplished in a rather round-about way. When the overcurrent relay is actuated, it opens the charging circuit, taking all load off the engine. This causes the engine to speed up and trip the overspeed relay, which shuts the unit down through the control relay. This overcurrent relay must be reset by hand, which means that once it is tripped, the engine will remain shutdown until the USCG makes its next visit.

Each engine is protected against high jacket water temperature and low lube oil pressure by a tenth relay, in series with the control relay. When this is tripped, it also has to be reset by hand.

Automatic Lamp Change

The problem of replacing a burned out lamp in the lighthouse tower was solved by installing a single piece of equipment, an automatic, turret-type lamp changer. Consisting of a square-shaped, revolving turret, with a 1000-watt lamp at the 12 o'clock, six o'clock, and nine o'clock positions plus a lampchanger coil and a filament series coil.

The revolving turret is installed in the lighthouse's cylindrical lens and is kept in proper position by a stop pin, attached to an escapement gear. This stop pin is held by a latch pin which in turn is attached to the armature of the lampchanger coil. As long as this coil is de-energized, the turret is kept from rotating. However, as soon as the filament in one of the four lamps burns out, the armature of the filament series coil is actuated, energizing the lampchanger coil.

This causes the lampchanger coil armature to unlatch the escapement stop pin, allowing the turret to rotate under action of a small DC motor. After a quarter turn, when a new lamp has been brought into proper local position, the armature of the filament series coil opens the circuit of the lampchanger coil, de-energizing it and allowing the armature latch to engage the escapement stop pin. This completes the operation. During its monthly visit the Coast Guard replaces burned lamps.

Monthly Maintenance

All equipment at Sand Island Light is checked thoroughly by the Coast Guard during its monthly visit. The crew arrives in the 180-ft tender Blackthorn and brings in all supplies by motor whaleboat. When the 1000-gal storage tank, mounted high against the lighthouse's outside wall, needs refueling (usually twice a year), the 55-gal drums are brought ashore in much the same way as the diesel engines were.

They are rolled over the granite blocks on ramps and are unloaded by means of a motor-driven transfer pump. Each diesel has a lube oil capacity of 6½ gals., more than enough for a typical month's 150-300 hours of operation. The jacket water in each engine is checked, all lube oil, fuel oil and air filters are inspected, and water is added to the batteries as needed.

Engine & Equipment Installation

The two one-cylinder, diesels are arranged end-to-end on the small engine-room floor. They are self-contained units, with all auxiliaries mounted directly on the engine frames.

Fuel oil is drawn from the 1000-gal storage tank by individual, ¼-in motor-driven pumps, powered by the generators not the batteries. It then flows to small service tanks in the base of each unit and passes through filters to the injection pumps and nozzles. As a precaution, the overflow line from the service tank to the storage tank was made larger than the suction line.

Lube oil is stored in the crankcase of each unit and is circulated under pressure to the pistons for cooling and to all working surfaces by built-in lube pumps, driven off the end of the governor shafts. Main bearings are splash lubricated. A non-detergent oil is used and filtering is handled by cartridge-type filters.

Jacket water (2½-gal capacity) is circulated through each engine by a built-in, engine-driven circulating pump and is radiator-cooled. The radiator fan is v-belted to the crankshaft and maintains the water at an operating temperature of approximately 160° to 180°F.

Engine air is supplied through oil-bath type filters. Exhaust gases are expelled through lines equipped with flexible metal hose and horizontal silencers. Vibro-Isolators support each engine's weight and absorb vibration.

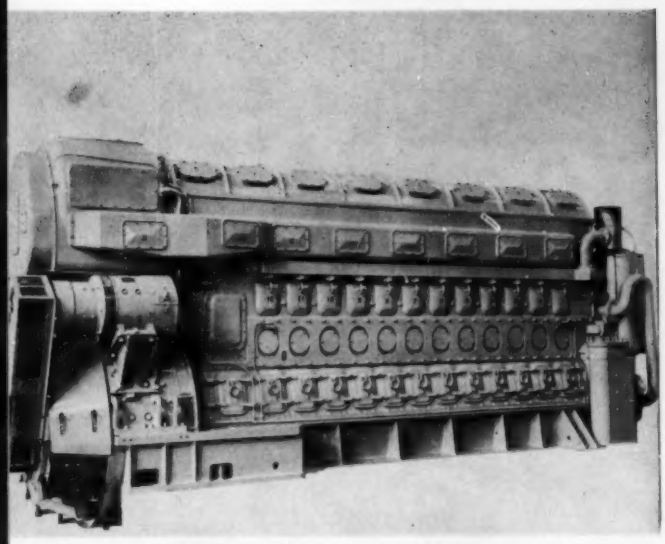
Summing Up

With this equipment, Sand Island Light should remain in service for another generation or more, or for as long as brick and mortar can withstand the years. In the sense that it is a self-operating light, Sand Island is one of the most modern on the Gulf Coast, despite the date of its construction.

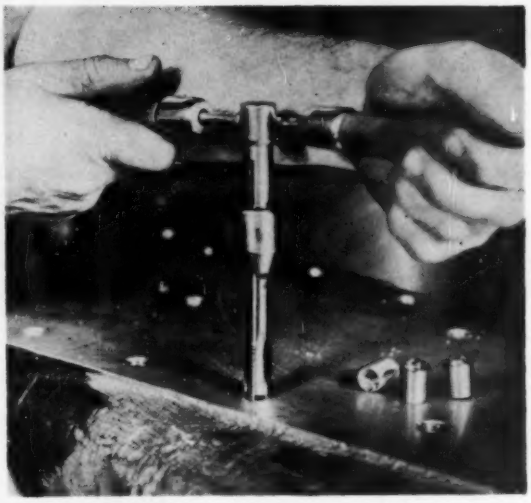
Diesel dependability means lower operating costs for the Coast Guard and eliminates unnecessary 3-hr, 30-mi trips to the light to replace defective parts or make adjustments. By reducing the number of such trips to one a month, the two diesel engines are making a valuable contribution to Coast Guard efficiency. Most of all, however, they are contributing to the continued safety of ships at sea.

Principal Equipment

Engines and Generators	Fairbanks-Morse & Co.
Governors	Fairbanks, Morse & Co.
Fuel System	
Solenoid	Automatic Switch Co.
Injection pumps	Diesel Engineering & Mfg. Co.
Transfer pumps	Autopulse Corp.
Filters	Purolator Products Corp.
Lube Oil System	
Pumps & Filters	Fairbanks, Morse & Co.
Low-pressure cut-out	Synchro-Start Products
Cooling System	
Radiators	Yates-American Machine Co.
Jacket water pumps	Fairbanks, Morse & Co.
High-temperature cut-out	Synchro-Start Products
Air Filters	United Specialties Co.
Exhaust Silencers	Maxim Silencer Co.
Starting contactor	Cutler-Hammer, Inc.
Overspeed cut-out	Fairbanks, Morse & Co.
Overcranking, Reverse current relay	Hartmen Electrical Mfg. Co.
Running contactor	Hartmen Electrical Mfg. Co.
Overload relay	Square D Co.
Field rheostat	Ohmite Mfg. Co.
Isolating circuit breakers	Westinghouse Electric Corp.
Starting, Field and Sequence relays	Struthers Dunn, Inc.
TVR relay	Electric Storage Battery Corp.
Astronomical time switch	Sangamo Electric Co.
Automatic lamp changer & Flasher	Wallace & Tiernan, Inc.
Batteries	Electric Storage Battery Corp.
Agastat relay	AGA. Div. of Electric Stop Nut Corp. of America

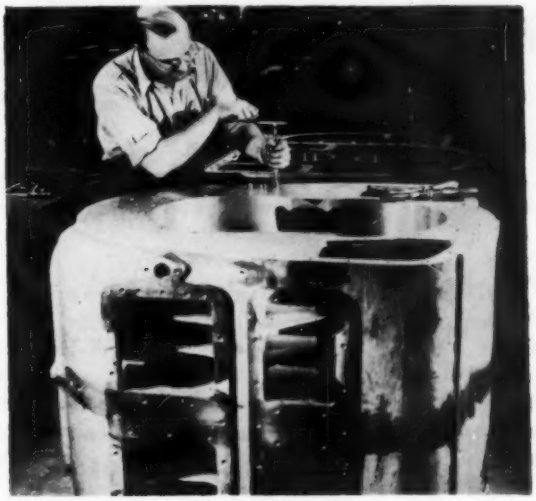


232 stainless steel wire thread inserts protects the aluminum threads in the blower casting of the Fairbanks-Morse diesel.



Holes are drilled when blower casting is machined. Then threads are tapped with Heli-Coil tap to receive stainless steel threads.

Inserts are wound into all threaded holes in blower casting prior to assembly to the engine and attachment of air ducts and covers.



Thread Inserts Strengthen Engine

WITH simple wire thread inserts, Fairbanks-Morse solved a weight *vs* strength design problem. It has put 232 permanent, stainless steel threads in the aluminum positive-displacement blower of each model in its line of 38D stationary opposed piston engines. As will be noted, the rotary blower is cantilevered from the control end of the engine. Aluminum is required for this assembly to reduce the stress on the end plate to which it is attached and to reduce the total engine weight.

However, several air ducts, cover plates, and auxiliary equipment must be fixed to the blower with steel screws. Threads tapped in unprotected aluminum tend to strip and wear. In order to guard against the possibility of screws working loose, stainless steel wire thread inserts made by the Heli-Coil Corporation of Danbury, Conn., are installed in 232 holes on all surfaces of the blower. Both $\frac{3}{8}$-16 x $\frac{3}{4}$ and $\frac{1}{2}$-13 x 1 inserts are used.

The method of installing inserts is shown. Holes are drilled at the same time the casting is machined. Then the threads are tapped with Heli-Coil taps. The inserts are wound in, resulting in hard, smooth permanent threads ready to receive the machine screws. Because of the self-anchoring effect of the external threads of the inserts against the aluminum threads of the casting, the screws do not work loose and the inserts remain in place during the life of the blower. The blower can easily be removed for periodic overhaul and inspection without danger of damaging the stainless steel threads.

Smallest size Oiltab is 1-in in diameter and equivalent to 1 quart liquid strength. Engine lube oil capacity determines size and number of pellets that are required.

Pelletized Additives Simplify Storage and Handling

By George T. Smith Product Advisor, Improved Products, Inc.

Additives developed for the cleaning of lube oil, water, and/or fuel systems are now available in pellet form.

ADDITIVES can be maintenance tools. When properly used, they can reduce maintenance and increase efficiency. Just like tools however, there are all kinds of additives. Each is designed to do one or a number of jobs and produce specific results. Again like tools, besides being able to do the job properly, they should be in some convenient form to incite their use.

The additives we are going to talk about in the following are condensates in pellet form. Just as other additives, they are compounded to do certain jobs. But before getting into just what they were designed to do, lets take a closer look at this pellet angle.

Most of us think of additives in liquid form. Since the pellets do not employ a liquid to carry the working chemicals, they represent a saving in size and weight of approximately 85% over products of the liquid type. This in turn, makes storage and handling of the pellets an easier job.

It also makes using the pellets easier. For the average engine found in construction equipment, one or two pellets, a little larger than a package of mints, will do the job. All that needs to be done is to unwrap the pellet and it is ready to use. The liquid capacities of the engine determine what size and/or the number of pellets that are required.

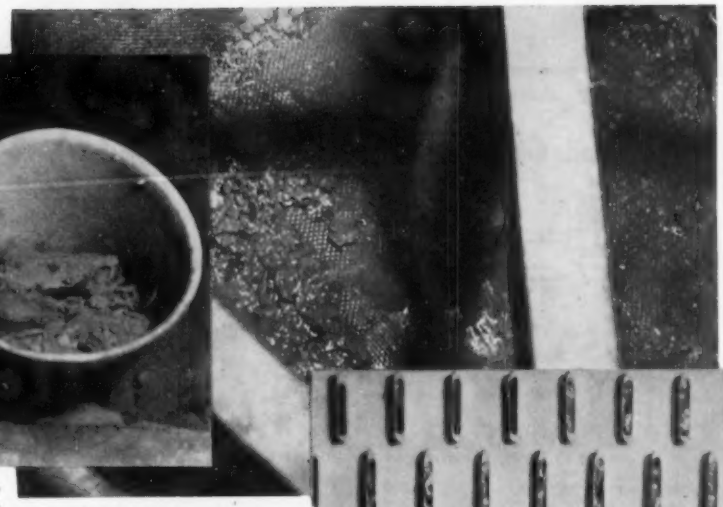
Water Treatment

"Watertab", as the pellet for this application is called, has been compounded to act as a corrosion inhibitor. It was developed to adjust the pH factor of the cooling water and add metal protection chromates, complex phosphates and silicates in the optimum chemical proportions for inhibiting most field waters. Tests indicate Watertabs to be 100% effective in corrosion control and about 85% effective in inhibiting scale bearing waters.

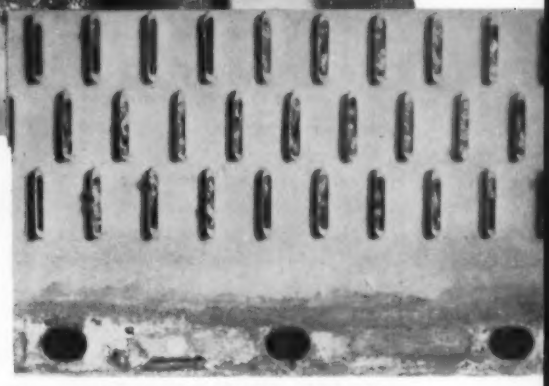
Personal experience in cleaning hundreds of field engines, while operating a field service on the West Coast, revealed the majority of field waters with their saline bicarbonate properties often exhibited corrosive action by pitting, electrolysis and erosion of metals exposed to cooling system water. Where most scale can be removed, even by on-the-job methods, the restriction of radiator tubes is for the most part due to iron oxide tubercles. These are the result of corrosion attack on engine block metal. They finally break loose and, carried by the normal flow of the water, are deposited in the radiator tubes.

Such a condition cannot be overcome by acid or caustic chemical treatment, for if either agent could dissolve the tubercles it would injure the engine and radiator. If a new engine is well treated with Watertabs the chemicals will penetrate the porosity of the metal and give a

Radiator pan tubercles are shown in paper cup. Also seen are crank housing crusts.



Iron oxide tubercles being flushed from engine block. These cannot be chemically dissolved but proper water treatment prevents formation.



Normal water flow loosened tubercles resulting from engine block corrosion and carried them into the radiator tubes fully closing them up.

The purpose of adding Dieseltab to fuel oil is to give fuel a gentle cleaning action. Sleeve shown is from engine using treated fuel.

lasting protection against corrosion and form a protective film that will defy many water scales. Watertabs are designed to stop the corrosion in an old engine *but they will not clean up the existing tubercles already deposited in the radiator tubes.*

Protection is assured so long as the radiator water has a clean yellow color. Distilled water although helpful in controlling water scale offers no protection against corrosion. The pellets for commercial engines come in various sizes for treating cooling system capacities from 5 to 200 gal. The smallest Watertab is 1-in in diameter by 1¾-in long, treats a 5-gal capacity system and bears a distinct yellow chromate color.

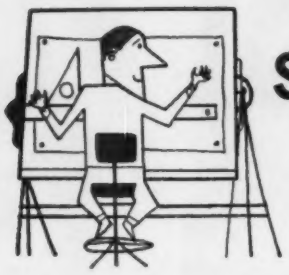
"Dieseltabs"

The primary purpose of this product is to clean. Therefore Dieseltabs are not intended to alter the cetane rating of diesel fuel. From the time they enter the fuel system until they become completely combustionable products, the parts touched including lines, screen, metering system, injectors and combustion chamber are subjected to a gentle cleaning action. Sizes beginning at 1-in diameter by 1¾-in long, designed for cleaning a maximum of five gallons of fuel are available. The equivalent to a barrel of liquid cleaner in the form of Dieseltabs weighs less than 80-lb and can be dropped through a man hole opening in large tanks.

"Oiltabs"

Like the Dieseltab this product's primary purpose is also to clean. Oiltab is compounded, based on the assumption that the engine manufacturer designed and built his engine to certain tolerances and therefore consulted with major oil company engineers in order to obtain a certain weight oil to meet such engine-fit-tolerances. It is not intended that this product change the oil viscosity which has been recommended for the particular engine being treated, nor change the nature and purpose of the engine oil. Since the Oiltab formula does not employ a liquid, they cannot dilute crankcase lube oil. In cleaning the engine's working parts of sludge, particularly the wax and tars, the action is slow and safe. Sludge is gently peptized and put into suspension in the base oil where it can be released to the filter or drained at the regular oil change.

Oiltab can be obtained in various sizes for commercial engines beginning with the smallest being 1-in in diameter by 2¼-in long. This size is equivalent to 1 quart liquid in chemical strength. Since Oiltab employs no oil vehicle there is no Federal tax on it.



service section

Recent engine and equipment modifications, procedures and recommendations straight from the different manufacturers to you

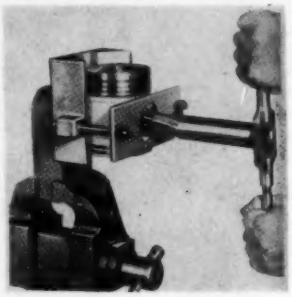
GM—Piston Bushing Reaming Set—Series "51", "71", and "110" engines . . .

New piston bushing reaming sets have been developed and made available for Series 51, 71, and 110 engines. These sets are designed to permit the accurate reaming of replacement piston pin bushings within factory specifications. Their use should result in substantial reduction in service costs to the engine owner.

Piston bushing reamer sets J 4970-A, J 3071-A, and J 5131 for Series 51, 71 and 110 engines respectively, consist of:

Two-step reamer
Piston retaining fixture
Reamer guide bushing

Orders for the piston bushing reamer sets should be directed to the Kent-Moore Organization, Inc., General Motors Building, Detroit 2, Michigan.



EMD—Engine Low Oil Pressure Tip . . .

Recently we heard of a case of low oil pressure on a six year old engine which we are passing on as a "tip". Low oil pressure in this case was caused by a hole chafed in the 3/8-in tubing oil line between the suction strainer housing and the governor.

This line is used to transmit lube oil pressure to the high oil suction protective device in the governor. The chafing occurred where the tubing passes through a metal clamp.

Any leak in this high suction line allows air to enter the lube oil system and reduces lube oil pressure. To determine how great a pressure drop takes place, we disconnected the line at the governor of a 16-567C engine and found the oil pressure dropped 10 to 12 psi both at idle and at full speed.

In case of engine low oil pressure, we suggest the high suction line be inspected. If through repeated removals the clamp has been damaged to point where it is chafing the line, either the clamp should be replaced or the tubing taped or otherwise protected.

I-H—Storage of Shop Rebuilt IH Fuel Injection Pumps (Off the Engine) — All Models . . .

International Harvester recommends the following preparations be made prior to placing an overhauled H1 fuel pump that has been tested in storage.

1. Drain engine oil from the pump sump.
2. Put an approved flushing oil in the pump sump and use it as a fuel in the pump mechanism.
3. Run test stand for five minutes, then shut down.
4. Start up again, run test stand for one minute and shut down.
5. Start test stand again and run for four minutes.
6. Do not drain flushing oil from pump mechanism, as it acts as a rust preventive for the inner pump mechanism and all the various parts.

Note: All inlet and outlet fittings must be capped with clover enclossures before storage.

It is recommended that a flushing oil that will meet military specifications, grade 1, preservative oil (Mil-L21260) be used. Oil companies have flushing oils meeting these specifications. For emergency field use only, good SAE-10W oil may be used.

EMD—Model 567C Engine Pistons . . .

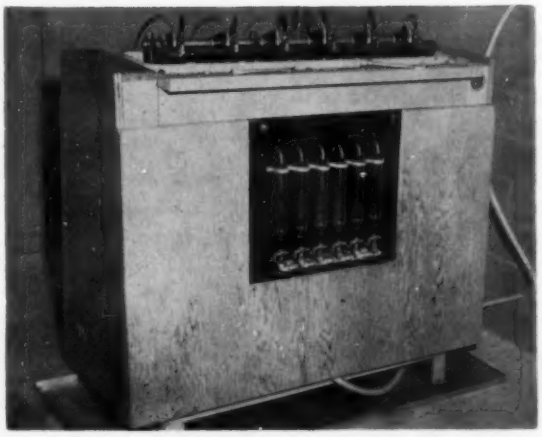
A design improvement incorporated in pistons used in Model 567C engines since December, 1954, and available at all EMD parts warehouses, provides a reduced diameter, referred to as a relief at the bottom of the third compression ring.

From this point the piston tapers out until normal piston diameter is re-established, approximately 1¼-in below the third compression ring groove.

This relief permits better lubrication between the piston and cylinder liner wall at a point on the piston where oil film is important to satisfactory piston operation and compression ring life. Pistons with the taper can be identified by placing a straight edge along the side of the piston and noting the clearance just below the compression rings.

All pistons for use in "C" engines will have the taper applied any time they are received at an EMD factory branch for check and relubrizing.

news of our industry



Injector Rebuilding Service

Located in the Rio Grande Valley at San Juan, Texas, is one of the largest and best-equipped plants in the Southwest devoted exclusively to the reconditioning of injectors for General Motors diesel engines. It was started two years ago by Stewart & Stevenson Services, Inc., a major GM distributor, and now performs injector repair work for all of the organization's branches as well as for many other GM diesel distributors and users all over the country.

Headed by C. F. Beal, the plant strives to keep up with the latest and most modern methods of service. Its reconditioning department is housed in an air conditioned dust-proof building to operate under the cleanest possible conditions. Only genuine Detroit Diesel parts are used and all procedures are set up in accordance with the exacting standards of this GM division. First view to the right shows inspection and test procedures. Below that is a closeup of the "run-in" test stand used after first assembly to test mechanical performance and meter and measure the exact amount of fuel through each injector.

Other equipment includes precision hones and centerless lapping machines for reconditioning plungers and bushings. And to insure perfect fitting of the various parts used in remanufacturing GM Series 71 and 110 injectors, special air and electronic gauges have been installed which measure in millionths of an inch. Each completed reconditioned injector is backed up by an unconditional guarantee from Stewart & Stevenson to meet new performance standards.

new products . . . . . Page 66

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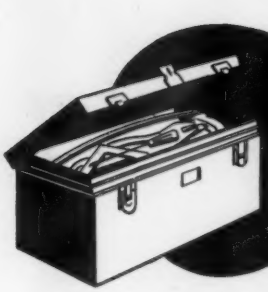


Straight from the Tool Box

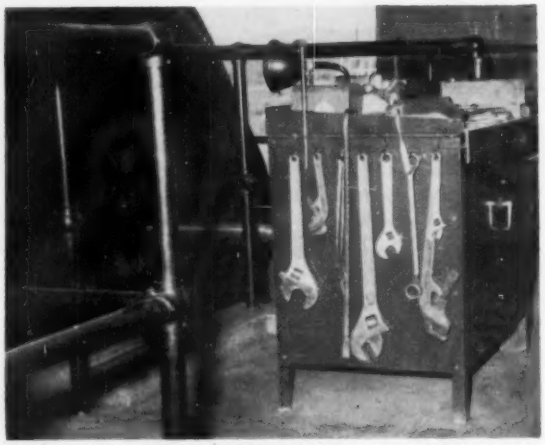
This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

Handy Tool Cabinet

L. W. Fitzpatrick, Jefferson City, Missouri—We have saved and will continue to save a considerable amount of our power plant operator's time by installing tool cabinets near the engines. By the use of these roomy, compact tool cabinets located near each of our engine units, long trips to the central tool crib have been eliminated.

Operators have a complete assortment of small, necessary, and special hand tools as well as emergency and inspection lights, ready for immediate use at all times and located just a few feet away from the point where they are needed.

Only large, heavy tools and the specialized parts are kept in the central tool crib under inventory control. Since these are seldom used, there is no undue hardship placed on the men who use them infrequently.



Mr. Fitzpatrick is certainly taking advantage of a time-saving practice for keeping his men doing the skilled work necessary rather than spending time walking to and waiting at the tool crib. Extension of this idea has been proved an additional help when routine maintenance is to be done. All parts and supplies are loaded on a dolly and rolled to wherever needed in one trip—Ed.

Caution on Chrome Plating Piston Pins

E. J. Feasey, Montreal, Quebec—While perusing your magazine, Diesel Power, of August 1955, I came across a short article on page 49 by Mr. Tom Moore of Lowell, Michigan, entitled "Extending Piston Pin Life."

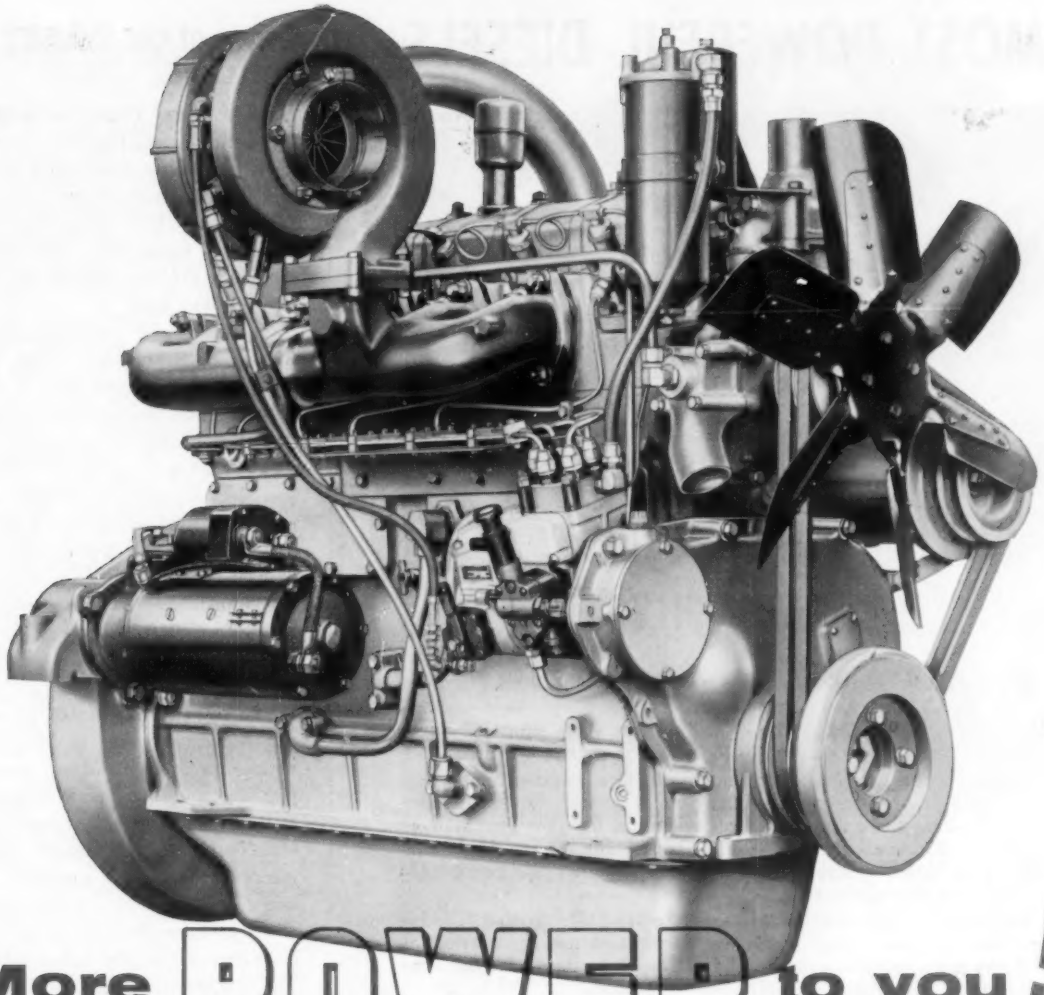
By virtue of experience with this practice over quite a number of years, a word of caution might be in order to those who might wish to take advantage of this suggestion.

After the plating of a new or used piston pin, even if the wear rate is nil the pin must not be considered to have an indefinite life. Therefore a conservative life expectancy should be set up, after which it would be advisable to make new piston pin renewals. In this way, serious engine trouble and expensive downtime may be avoided.

Cases are known to the writer where piston pins have been magnaflux-tested before and after reconditioning, and yet fatigue failures have occurred shortly after they were placed into service.

It is the writer's opinion that if plating is required to give an uninterrupted performance of a certain part over the manufacturer's maintenance instructions, the pin or other part should be plated at the time of its initial production.

We go along with Mr. Feasey's comments regarding possible reduction in fatigue strength as the result of chrome plating. However, serious reduction only occurs when improper procedures result in severe hydrogen embrittlement. More than 50% fatigue strength loss has been reported in some cases. Proper plating procedures and heat treatment (see "Chromium for Crankshafts", Diesel Power, August 1955), will minimize harmful effects. In short, know how good your plater is—Ed.



More POWER to you!

WAUKESHA Diesels

Specifically designed for truck service—the Waukesha 135-DK Series high speed Diesels in the 130 hp to 190 hp range are setting high performance and economy records in re-powering 30,000 to 80,000 lb. g.v.w. units. Both are 426 cu. in., six-cyl., 4¼-in. x 5-in. The 135-DKB Normal Diesel develops 147 hp at 2800 rpm. In the 135-DKBS Diesel (shown) output is boosted to 185 hp at the same rpm by turbo-supercharging.

WAUKESHA MOTOR COMPANY
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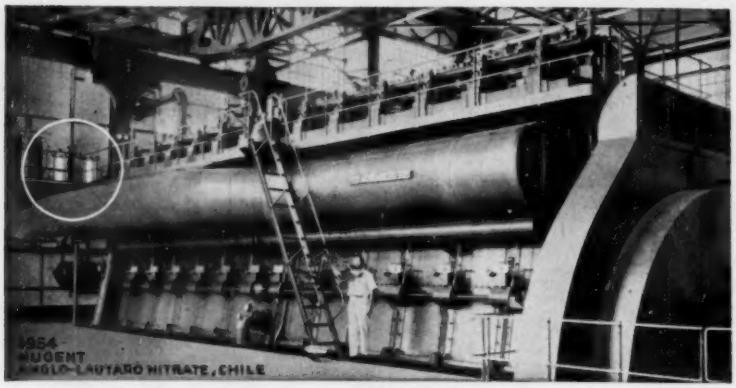
New York • Tulsa • Los Angeles

288

MOST POWERFUL DIESELS



. . . rely on NUGENT FUEL OIL FILTERS!

● The giant diesel shown above is one of two, 9,600 hp. Nordberg engines installed for the Anglo-Lautaro Nitrate Corporation at their plant in Coya Sur, Chile. The diesels are the most powerful single units ever built in the Western Hemisphere.

Included as original equipment on each of these engines is a Nugent #4L4 twin transfer filter (shown in circle above) for preliminary fuel oil filtering and a Nugent #4L Duplex fuel oil filter (not visible) to provide the final filtering. The Coya Sur installation is another example of Nugent filters being installed as original equipment by a leading diesel manufacturer.

Size for size, Nugent filters of the above type offer greater filtering area than any other filter on the market. In addition, the lubricating oil filters make possible a choice of full flow or by-pass with the same unit. Simple piping makes installation no problem.

No matter what the size of your own diesel power supply—no matter where it is installed, there is a Nugent fuel or lube oil filter to meet your needs. Write for complete information.

◀ Close-up of a Nugent #4L4 filter of the type used for fuel oil transfer on the giant diesels at Coya Sur. Recharges are inexpensive and simple to replace.

▶ Nugent duplex filter of the type used for final fuel oil filtering on the diesels at Coya Sur. By actual test, removes 99.8% of all foreign solids from fuel oil.

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news of our industry

Mobile Power Plant for Army

Westinghouse Electric Corp. reveals that it has delivered a 5000-kw gas turbine railroad-mounted power plant to the U.S. Army for use in devastated areas. The components of the plant are arranged on two 54-ft long railway cars.

The generator car contains the 5700-rpm gas turbine, which is designed to burn diesel fuel; a geared speed reducer for enabling generator operation on one of two speeds (3600 rpm for 60-cycle power or 3000 rpm for 50-cycle power); a 2400-v generator and its exciter; and the gas turbine's starting motor. The transformer control car has a multi-voltage transformer with output from 2500v to 15,000v, high and low voltage switchgear, and two diesel generators for auxiliary power.

The rail unit is adapted for standard American gauge of 56½ in, as well as for foreign railway gauges of 60, 63, and 66 in. Westinghouse states that one such unit could easily satisfy the electric power requirements of the average industrial plant and that several operated in parallel could produce adequate power to operate even the largest industrial plant. The corporation had built railway-mounted steam turbine power plants during the war which were also rated at 5000 kw, but which required eight cars for housing.

New Lube Oil Consumption Test

An electrical weight sensing device is being used to test the quantity of lubricating oil used by jet engines at the Norton Air Force Base. The new oil weighing system, designed by the Air Materiel Command, uses load cells and precision indicating instruments supplied by Baldwin-Lima-Hamilton Corp.

Weight rather than volume is the measure of quantity consumed, it was explained, since volume is affected by aeration of the oil. Weight readings are taken while the engine is running and the oil warm. At the same time, engine thrust is measured by the load cells.

news of our industry

CNR To Buy 173 Diesel Units

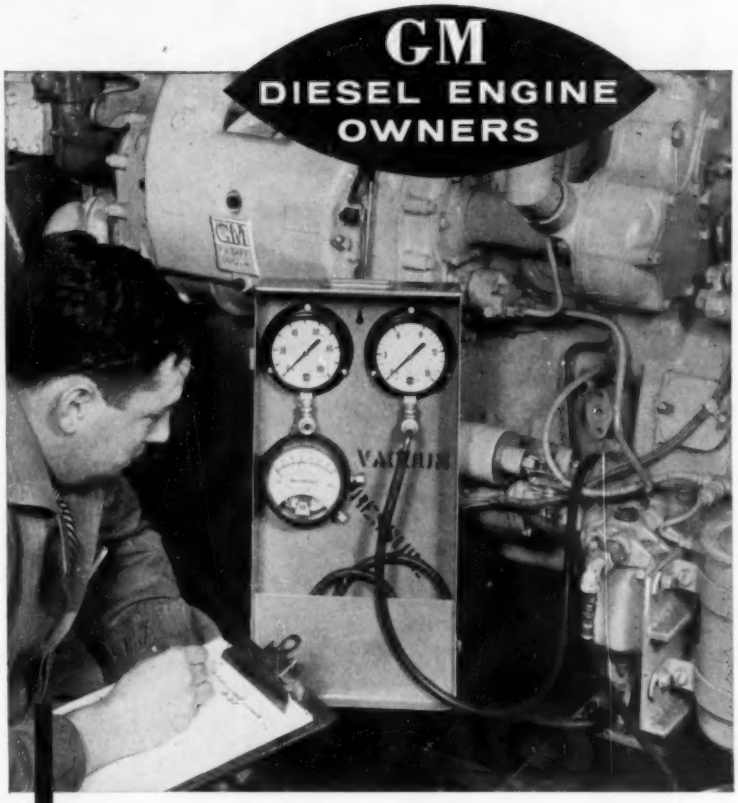
To meet the 1955 portion of its 5-yr dieselization program, Canadian National Railways has announced the placement of orders, totaling $25 million, for 173 diesels.

Since 1951, the road has bought nearly 700 units for use in through freight service, yard operations, and passenger duty. A breakdown of the recent order shows that General Motors Corp. will build 32 1200-hp switchers and 45 1750-hp road locomotives; and that Alco Products, Inc. will deliver three 1000-hp switchers. The remainder of the order will come from Canadian Locomotive Co. and Montreal Locomotive Works, type and number of locomotives undisclosed.

Solar Engineering Exhibit

Among working models to be displayed publicly at the World Symposium on Applied Solar Energy to be held Oct. 29 through Nov. 13 in Phoenix, Ariz., will be a 5- to 10-hp sun-driven engine manufactured in Italy, it was revealed. The device incorporates a flat-plate collector that uses the sun's rays to evaporate sulphur dioxide which then operates a vapor engine. The gas is condensed by a water-cooled condenser and returned to the collector in a continuous cycle.

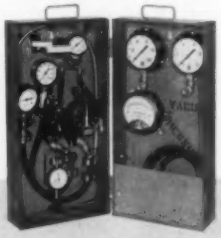
Other exhibits will include a model of a solar-heated house, a sun energy calculator which computes sun energy on a surface for any latitude and time, a "shade dial" which determines the sun's angle in the sky for locations at any latitude and for any time of day or year, a sunlight intensity measuring instrument, a "solaranger" for studying sunlight pattern for any latitude or time of day or year, a production model of a solar water heating collector and steam generator from Israel, a solar food cooking oven, solar stills to change salt water into fresh water, solar furnaces, a silicon solar battery operating a small motor, a cadmium sulfide solar battery, and a solar portable radio transmitter.



You'll cut "down time" with the
KENT-MOORE *RATE-MAKER*
Diesel Diagnosis Test Kit

Fact is, you'll reduce diesel "down time" on *two* fronts when your shop is equipped with a portable Rate-Maker Diagnosis Test Kit. First, you'll catch most potential trouble-makers when they're still "potential" by using the kit to run your periodic preventative maintenance checks. And second, if one of those unpreventable breakdowns does occur, the kit provides you with an accurate trouble-shooting tool that'll help you speed repairs by quickly locating the cause of the failure.

Yes, the kit contains all the tools you need to check timing, compression, exhaust back pressure, engine R.P.M., blower intake, restriction, air box, oil and crankcase pressure, and cylinder liner position on all Series 71 and Model 6-110 G.M. Diesel Engines. What's more, it's so compact and convenient you can take it to the job . . . in the shop or out in the field! So cut "down time" in your shop! Order your Kent-Moore Rate-Maker Diesel Engine Diagnosis Test Kit today!



▶ ILLUSTRATED—the J 4209-41 Basic Kit plus fuel pressure gauge and compression gauges for both Series 71 and Model 6-110 Engines. Note that hinged case can be separated for greater convenience in use. Standard Kits available for: Series 71 engines only; Model 6-110 engines only; GMC Trucks; GMC Coaches; and Le-Tourneau-Westinghouse installations. Write for information now!

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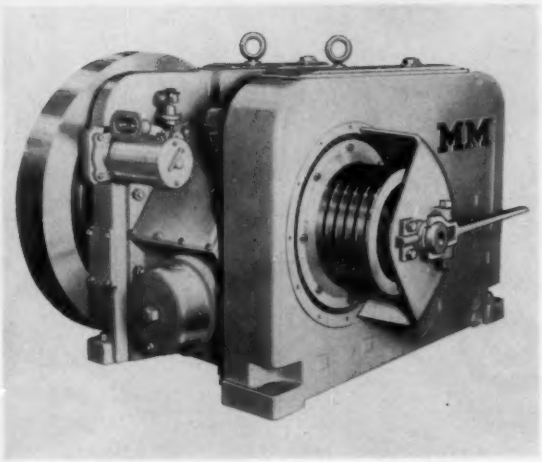


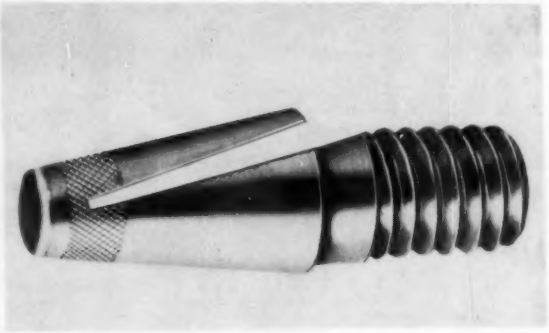
Long-Running Power Unit

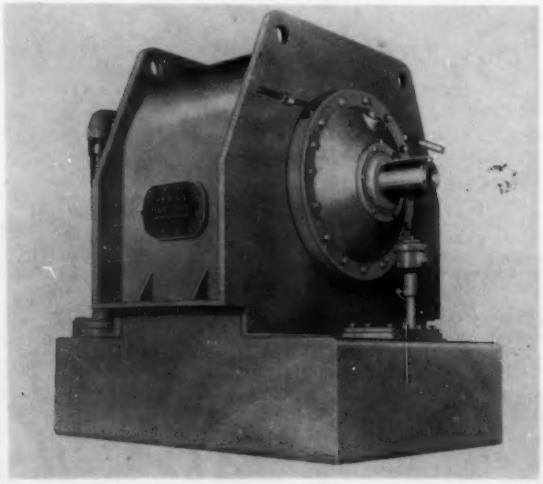
A new radial cooling system has replaced the conventional radiator in this 2-cyl engine in production by Minneapolis-Moline Co., Minneapolis 1, Minn. Water pump, pulleys, fan, fan belt, and radiator hoses have been completely eliminated. Water is circulated through a cast-aluminum cooling unit built into the flywheel. The crankcase has an air ventilating system and is kept under uniform temperature by water circulating through the jacket in the base pan casting.

During 1954 and 1955, a number of these engines were test-run in oilfield pumping installations, operating continuously for a full year without need for any kind of servicing. Called the MM Timeline 168, the present model is rated 20 hp at 1200 rpm and burns natural gas. New units are being developed to produce 15 and 26 hp. Future production for LPG is also anticipated.

Time and Temper Saver

Automotive jobbers are now stocking small slotted bolts called Vellubolts, designed to eliminate the headache of getting oil pans and oil-pan gaskets back into place on the engine block. Manufactured by The Vellumoid Co., Worcester 6, Mass., they come four to a set for each truck or car size. Operation is simple. Each Vellubolt is screwed into a corner of the engine block by hand. The gasket is snapped over the bolts, then the oil pan, so that they are both held perfectly aligned in place. Ordinary bolts are next screwed on, the Vellubolts removed by hand, and the job is done.





Packaged Oilfield Fluid Drive

Now available in an enclosed, self-contained package is an oilfield version of the Gyrol fluid drive. American Blower Corp., Detroit 32, Mich., designates it Type VS Class 2F, and has built it to fit standard 18-in channel skids. Sizes come 400 to 1000 hp for operating speeds up to 1200 rpm.

Designed for compounding multiple drive engines on large drilling rigs, the unit is said to start smooth from standstill against full connected load by just advancing the engine throttle. Acceleration rate is controlled by throttle rate or scoop tube advance to permit speed selection without stalling. Of value in slow operation, slip increases at low speed to extend range of output speeds to low rpm. Pressure can also be held with output shaft stalled, without harm. The drive is a 1-to-1 torque transmitter, insuring against overload; and its end bell-type housing provides full accessibility.

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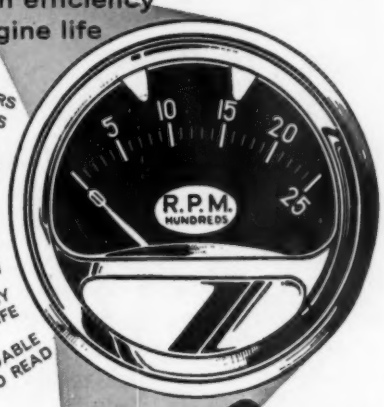
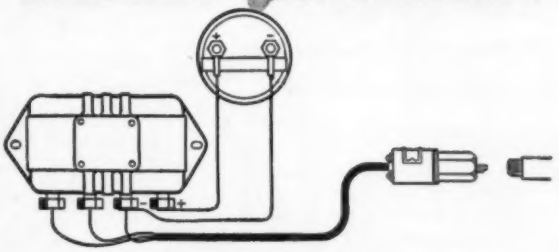


with new *Sun*
MECHANICAL DRIVE
ELECTRIC TACHOMETER!



Now, New Sun Mechanical Drive Electric Tachometer for diesel engines gives consistent, more accurate RPM readings for greater diesel efficiency and economy!

Operation is simple and foolproof. The new Sun Power Units are available for standard S.A.E. drive ratios—and S.A.E. mechanical drive outlets. Troublesome, long drive shafts are eliminated. The Sun Transmitter Unit attaches to any S.A.E. mechanical drive outlet where electrical impulses are picked up and transmitted to the Power Unit and then relayed to the "Tach" head in terms of RPM.

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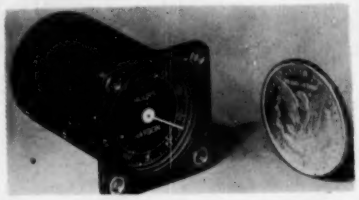


Engine Hour Indicator

Availability of a running time meter, which indicates hours of engine operation for 60-cycle diesel generating units up to 10,000 hr, has been announced by Haydon Mfg. Co., 245 E. Elm St., Torrington, Conn. It has a dial-type face, weighs less than 6 oz, and has a power drain of about 2 w. Hermetically sealed, it is said to meet military shock (25 g) and vibration requirements.

The 1½-in diam by 2¾-in long unit mounts behind or in front of the mounting panel; electrical connections are from the back through solder-type glass-to-metal sealed terminals. An external pointer is also available which can be set to show operational hours before next overhaul for automatically scheduling component replacements from known life expectancy data.

Load Hoisting Control

For control in load-lifting and lowering operations, Mefco Sales and Service Corp., 1509 Gardena Ave., Glendale 4, Cal., announces the Hydra-Set, a hydraulic instrument used as a link between the hoisting mechanism and the load. Accuracy within .001 in is claimed, independent of crane or hoist control system. It works by means of up and down control levers which can be remotely operated by remote control reels.

The instrument also serves as a crane scale, weighing the load as soon as it is suspended. Under known load weight conditions in precise mating or disengaging operations, the scale dial acts as a strain gauge, indicating unexpected loss or gain in registered weight. Standard models are available up to 20-ton capacity with 12-in stroke.

Plastic Steel

Claimed to be as easy to handle as modeling clay, Devcon, a combination of 80% steel and 20% plastic, is being actively marketed by Chemical Development Corp., Danvers, Mass. Originally developed for the metal working industry, it is now employed for filling holes in castings, bonding steel to itself or other metals, rebuilding worn sections, and for making dies.

It is now available in two types. Type A is a putty that can be applied to a vertical surface. Devcon B is a viscous liquid that can be poured. In either case, two hours after addition of a special hardening agent, the mixture is said to become a rigid, steel-like mass with no heat or pressure required. Practically no shrinkage occurs during hardening, it is further stated, and once set the metal remains durable and permanent.

Engine Control Valve

Automatic Switch Co., 391 Lakeside Ave., Orange, N. J., has designed a solenoid valve which is used by engine safety controls to shut off fuel when abnormal conditions, such as low oil pressure, high temperature, overspeed, low voltage, etc., occur.

The valve, available for any voltage, is opened manually and is automatically closed when energized by the control device. It can also be used to stop an engine with a remotely located pushbutton. Capable of mounting in any position, it is supplied with a heavy brass body and soft composition disc for tight shut-off.

Powder-Form Alloys

Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich., is making available a new series of alloy powders which are claimed to produce improved deposit efficiency when used in the company's "Spray-welded" applications, a process of overlaying surfaces with hard-facing alloys. Called Nos. 4, 5, and 6, the nickel-chromium, boron alloys are said to give 10% deposit efficiency improvement over previous series.

new products

Flow Indicator

Designed to indicate flow or lack of it through a pipe line is a compact unit, Model FI-200, produced by Gems Co., Newington, Conn. Flow actuates a switch that may be used to operate a warning signal. With relays, it can also operate preventive interlocks.

The body of the indicator is a standard pipe fitting for easy installation accommodating ¼-in to 3-in sizes. Any flow over 1.5 gpm causes indicator functioning; higher or lower points provided on special order.

500-KVA Generator

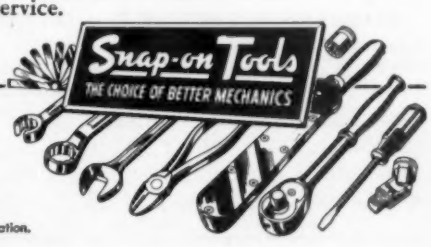
New and larger series of generators ranging up to 500 kva have been announced by Kato Engineering Co., Mankato, Minn. The new Model 92BROR shown here features an overhead belted exciter. It is a 500-kva, 400-kw, 3-phase, 60-cycle, 1200-rpm, 220/440-v generator.

The generator is also obtainable with a direct-connected exciter. It has a heavy welded steel frame with endbells of cast iron. A single bearing design is also available, adaptable to standard SAE bell housings. This frame size also accommodates generators from 150 kw through 300 kw at 900 rpm and from 200 kw to 450 kw at 1800 rpm. Standard voltages are available to 2300 v.

Emergency Screwdriver

The latest twist in tools is the "Flashdriver", a screwdriver with a built-in flashlight. Two batteries are housed in its heavy rubber handle to throw a beam of light on the work. The blade is tempered steel, tested for 500-lb torque. It's a product of B. D. Wolcott's Son's, Eatontown, N.J.

The fastest wrench you can put in the hands of a maintenance or production worker. Swiftly runs nuts or screws on or off—cuts costs—makes tough jobs easy. The Snap-on impact wrench delivers up to 2,000 powerful rotary blows a minute without twist or hammer shock to operator. Sets nuts solidly, or quickly reverses to break tough ones loose. ½" square drive takes sockets ⅜" to 1 1/16"—many accessory tools available. 2 models—115 volts, 220/230 volts. Available through Snap-on factory branch warehouses in principal industrial centers. Write for Snap-on Industrial catalog and new catalog of 4,000 hand and bench tools for production and service.



SNAP-ON TOOLS CORPORATION
8064-I 28th Ave., Kenosha, Wis.

*Snap-on is the trademark of Snap-on Tools Corporation.

new literature

Flaw Location
with dye penetrants is demonstrated in a 23-min color and sound film intended for training purposes. It shows all aspects of inspection from laboratory to production-line techniques and was produced on location by Turco Products, Inc., 6135 S. Central Av., Los Angeles 1, Cal.

Lead-Base Babbitt
material called Grac, claimed capable of substituting for any of the high tin-base babbitt metals for a saving in cost, is described in a 4-page brochure published by Graphitized Alloys Corp., 44 Trinity Pl., NYC 6.

Steel Terms Dictionary
32 pages full, is offered by LaSalle Steel Co., 1412 150th St., Hammond, Ind. Photographs, curves, and tables cover the technical data.

New Ideas in Storage
equipment for time and space saving are presented in a 16-pager from Frick-Gallagher Mfg. Co., 110 S. Michigan Av., Wellston, O. Product and in-use photos are included for more than 120 models listed.

Special Soft Solder Alloys
are described in chart form by Alpha Metals, Inc., 56 Water St., Jersey City 4, NJ, along with a listing of suggested uses.

Packless Expansion Joints
called ExpandZorber, a line of flexible pipe connections used to solve vibration and expansion control problems in piping, is described in a catalog from T. R. Finn & Co., Inc., Hawthorne, NJ. Design of the joints is said to eliminate reinforcing rings and equalizing spacers.

Flexible Metal Hose
and expansion joints, tradenamed Flexon, is the topic of an 8-page catalog released by Flexonics Corp., 1363 S. 3rd Av., Maywood, Ill. Construction details, specifications, and applications are covered.

Zinc in Corrosion Control
as coatings, pigments, and anodes, is detailed by American Zinc Institute, 60 E. 42 St., NYC 17, in a 32-page book. Its extensive areas of application are also reviewed.

Physical Property Data
for socket screws is listed in a new series of papers stocked by The Bristol Co., Waterbury 20, Conn. The data sheets are conveniently punched for binding.

Wire Gauge
and temperature conversion charts, pocket-size and printed on plastic, are free for the asking from General Electric Co., 470 Lexington Av., NYC.

FREE to Every Shop Operator

- Diesel Compression Testers
- Nozzle Testers for American Bosch, Caterpillar and Bendix Nozzles
- Cummins Injector Tester
- International Harvester Injection Testers
- General Motors Injector Testers
- Injection Pump Calibrating Stands
- Nozzle-Injector Cleaning Tools and Lapping Blocks
- Engine Overhaul Stands
- Engine Removal and Parts Dollies
- GM 71 Engine Tools

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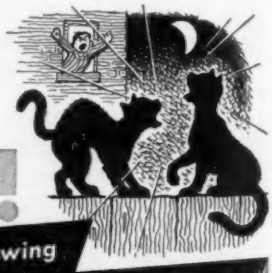

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— at the cats, but we can assure you they will throw your annoying, costly and unnecessary intake and exhaust noises for a loss. Burgess-Manning Snubbers are designed to silence noise from air, steam and other gases being discharged into the atmosphere, or air intake of engines, compressors, blowers, etc. These noises can be very costly to you in disrupted and incorrect oral communications, jittery personnel, poor neighbor relations, and even in compensation claims for impaired hearing. Burgess-Manning Snubbers are engineered to your needs.

Tell us your problem — let us recommend

BURGESS-MANNING COMPANY

Sound Engineering 755 East Park Avenue, Libertyville, Illinois

Dallas, Texas

new literature

Unalloyed Titanium Tubing
fabrication methods are detailed in an 8-page bulletin from Superior Tube Co., Norristown, Pa. Subjects include heat treating, pickling, welding, brazing, and machining.

Improvements in Tractors
and accessory equipment are considered in a 30-page booklet issued by International Harvester Co., 180 N. Michigan Av., Chicago 1, Ill. The new TD-24 torque converter diesel tractor, introduced in March, is also detailed.

Carbide Tool Life
can be increased and tool costs reduced by following recommendations in a methods manual published by Carmet Div., Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa. Contents include cutting grades, tool design, brazing and grinding procedures, chip control, and hints on setup and coolants.

7 Rules for Battery
maintenance have been combined into a cartoon poster, punched for hanging, by Exide Industrial Div., The Electric Storage Battery Co., 42 S. 15 St., Phila. 2, Pa.

Model GMXD Compressors
the latest vee-angle units of Cooper-Bessemer Corp., Mt. Vernon, O., are intensively treated in a 24-page bulletin. Developing 265 to 600 hp, the engine-driven compressors are available in 4 to 8 cyl.

Prevention of Deposits
and corrosion products from accumulating in the first place is considered the best policy to follow in keeping water-using equipment clean. However in some situations it may be less expensive to clean at intervals than to pay a high price for the ultimate in chemical cleanliness. In a new folder, Hall Laboratories, Inc., 323 4th Av., Pittsburgh 30, Pa., discusses the difficulties in deciding the best course.

Speed Reducers
and complete details on its new "Line-O-Power" units with capacities ranging from fractional to 150 hp are considered in a 40-page manual released by Foote Bros. Gear & Machine Corp., 4545 S. Western Blvd., Chicago, Ill.

Corrosion in Cooling Water
systems is surveyed for the years 1940 through 1953 by the American Petroleum Institute's Refining Div., 50 W. 50 St., NYC 20. Abstracts of published articles on phases of treatment proven satisfactory and in practice are included along with those which require further study and research.

Euclid's Twin Crawler
tractor, the TC-12, which is powered by two 194-hp diesels, has been illustrated and described in the latest literature available from that division of General Motors. When writing Euclid at Cleveland 7, O., ask for Form 601.

organizational news

Upped to Advertising Manager from his post as assistant advertising manager at Morse Chain Co., is John A. Janikowski. His duties will also include direction of the advertising activities of the company's new Canadian plant at Simcoe, Ont.

Joining Kewanee-Ross Corp. as heat exchanger development engineer is John A. Jost. He's been with Foster-Wheeler Corp. for the past 18 years.

John A. Jost

Charles M. Reagle

New York Domestic Territory management has been assigned to Charles M. Reagle by The Cooper-Bessemer Corp. Presently a vice president and director of the organization, Mr. Reagle is also manager of marine sales. His newest capacity will allow him close contact with growing applications of the company's products in the New York area.

Florida Diesel Engine Sales has a new manager, Royce A. Hill. He moves to this branch of the Detroit Diesel Engine Div., General Motors, from Texas where he was sales representative.

Ex-Chief of Los Angeles smog control, Gordon P. Larson has been appointed vice president of Oxy-Catalyst, Inc., to assist in development and application of the company's oxidation catalysts.

Gordon P. Larson

Here's Why

PERFORMANCE IS BETTER WITH Bendix STARTER DRIVES

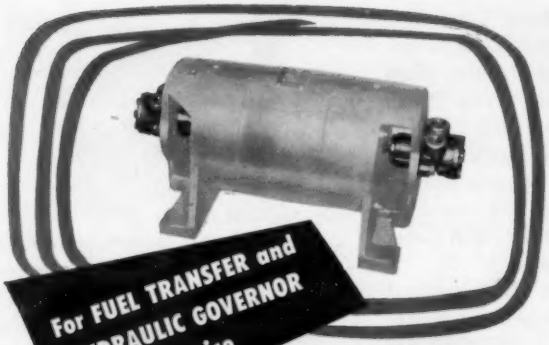
CHECK and COMPARE THESE FEATURES

- Starting motor can be mounted more easily and in more positions.
- Requires no actuating linkage—solenoid can be placed in any convenient position.
- Simple in design—has fewer parts—needs fewer adjustments.

It takes a truly outstanding product to receive over 100,000,000 endorsements. Yet, that's the number of Bendix Drives that have been installed. No other starter drive approaches this record of outstanding performance. That is why, whatever your type of diesel or whatever its purpose, it will pay you to specify Bendix* Starter Drive for the most economical installation and dependable performance. *REG. U.S. PAT. OFF.

ECLIPSE MACHINE DIVISION of Bendix AVIATION CORPORATION
ELMIRA, NEW YORK

Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.



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Canadian Affiliate: Ingersoll Machine & Tool Company, Ltd., Ingersoll, Ontario, Canada

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gives compression and firing pressures faster

SIMPLE RELIABLE COMPACT

Send for Bulletin K-100

The Model K-100 Kiene Pressure Indicator accurately measures compression and firing pressures — assures the proper maintenance of diesel engines — helps prevent costly down time. Only one moving part — no friction or inertia effects — no complicated adjustments.

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organizational news

Installed as Manager
of the Industrial Filtration Div. of U. S. Hoffman Machinery Corp., is Charles A. Wallace. Formerly assistant manager, he has been with the company for 24 years, first as automotive engineer and later a machine tool engineer.

Vice President's Assistant
in the tractor group at Allis-Chalmers Mfg. Co. is Robert S. Reaves, succeeding Harold W. Schudt who is now Canadian Allis-Chalmers, Ltd., president. Mr. Reaves first joined the company as a student engineer in 1935.

Robert S. Reaves

Jack McCann

Jack Errion

Two Sales Advancements
have occurred at LeTourneau-Westinghouse Co. Jack McCann, up-to-now manager of the company's Washington office, has become government sales manager and Jack Errion, formerly advertising promotion supervisor, is now sales promotion manager.

Assistant Director
of engineering is the new title for Howard J. Findley at Eaton Mfg. Co. Lastly manager of research, Mr. Findley will be working on research and engineering activities with all the 13 divisions and three subsidiaries of the organization.

Sales Posts at Tube Turns
a division of National Cylinder Gas Co., have gone to W. C. Robinson and Frank Briggs. Mr. Robinson has been appointed assistant sales manager in Louisville, Ky. He joined the company in 1944 as a sales representative in Pittsburgh. Mr. Briggs has been named to the staff of the Sales Development Dept. He has been with Tube Turns since 1942.

To Assist Engine Distributors
and serve the railroad industry and original equipment manufacturers in North America, Philip R. Coerper has been named sales engineer by Nordberg Mfg. Co.'s Power Chief Engine Dept. He'll make his headquarters in Milwaukee.

Philip R. Coerper

new products

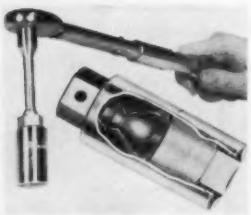
Safety Solvent

To replace carbon tetrachloride in cleaning operations, Turco Products, Inc., 6135 S. Central Ave., Los Angeles 1, Cal., announces that it has developed an improved Turco-Solv for removal of grease, oil, and carbon film from components of electric motors and generators. It is claimed non-explosive, non-flammable (flash-point over 200° F, TCC), and much safer than carbon tetrachloride or chlorinated solvents.

Plug-Holding Sockets

Two spark plug sockets with a special rubber insert for holding plugs have been announced by the Plomb Tool Co., Los Angeles 54, Cal. The rubber insert holds a spark plug securely in the socket, providing a means of removing and installing plugs quickly in hard-to-reach places on natural gas engines.

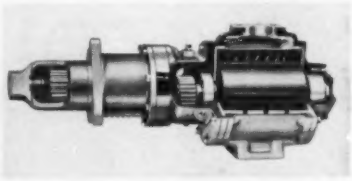
No. 5026HP is for ⅜-in drive and has a 13/16-in hex opening for turning 14-mm plugs. No. 5326HP has the same size opening, but is for ½-in drive. Both have a ¾-in male plug at the top, allowing socket to be



turned with an open end or box wrench. Extensions of various lengths can be used and sockets and extensions can be turned by any handle including a ratchet-head or other type of torque wrench, important for new gasketless plugs.

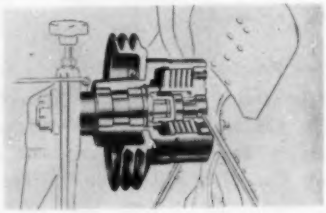
Air Starter and Fan Drive

Two new air-actuated devices for trucks and buses, an air starting motor and a thermatic fan drive system, have been released for field



installation by Bendix-Westinghouse Automotive Air Brake Co., Elyria, O.

Tradenamed Startaire, the motor is said to provide all-weather fast action starting of both gasoline and diesel engines with less space than required for equivalent electric starters. Of rotary multi-vane type design, the motor is equipped with a friction clutch and housing. Model 15 covers engines up to 1100-cu in displacement; Model 30 larger.



The fan drive system automatically controls and maintains engine coolant temperature at the most efficient operating level. A thermal element in a control valve causes fan engagement or disengagement depending on engine coolant temperature. More hp and greater fuel mileage are claimed since fan is disengaged much of the time.

The World's Leading Manufacturers of FUEL INJECTION EQUIPMENT for Diesel Engines

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AP174-754

new products

Tractor Shovel and Dozer

Two new diesel-powered rubber-tired machines have been developed by Clark Equipment Co., Benton Harbor, Mich. They both employ Waukesha engines.

The 15-cu ft capacity tractor

shovel, designated Model 12B, is for in-plant handling of bulk materials. It features a power-shift transmission, a torque converter with 3 to 1 multiplication factor, planetary wheel axle, and low-level bucket action. It has a 4-cyl engine of 42 maximum hp. A 12-v battery is incorporated for quick starting.

A turbocharged, 165-hp, 2200-rpm engine powers the Turbo-Dozer,

called Model 180. It has a 27-mph road speed, 4-wheel drive, and rear-wheel steering. Like the Tractor Shovel, it features power-shift transmission, heavy-duty torque converter, and planetary wheel drive axles. The 2¾-yd capacity bowl is raised and lowered by two double-acting cylinders, tipped back and forth by a 6-in cylinder to pry and lift, uproot and cut. Quick starting is made by a 24-v electrical system. A 50-gal tank permits an average day's work without refueling.

Multi-Purpose Valve Lubricant

Good metal-wetting qualities at low and high temperatures are claimed for No. 555 valve lubricant, latest product of Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa. It has an efficient temperature range of 40 below zero to 500 degrees above in bulk form and 20 degrees below to 500 above in stick form, and is recommended for hydrocarbon liquid and gas service.

High Voltage Tester

For checking the electrical potential of high voltage lines and equipment, I-T-E Circuit Breaker Co., Greensburg, Pa., is manufacturing the Glowtector, a safety device consisting of an electrode which is touched to the equipment being tested, a glow tube, and a hood shield. Recommended procedure for tests is first to touch the electrode to a known live conductor operating at 2200 v or more, or to the spark plug of a running engine to establish the condition of the glow tube. When the electrode is then applied to the equipment under test, if the tube fails to glow, it indicates a dead line and verifies that the equipment is safe to touch.

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Vernatherm thermostats by Detroit Controls have a reputation for solving knotty problems in the roughest kinds of service. Big engines doing big jobs rely on Vernatherm thermostats. Cooling system difficulties in millions of passenger cars have been eliminated. Why not investigate Vernatherm thermostats for your engines?

Pioneered by Detroit Controls to meet the needs of modern pressurized cooling systems, these superior thermostats are solid-charged for power and accuracy, specially engineered for each job.

Call on DETROIT sales engineers for test data and actual results in the field . . . or write for Bulletin 213.

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REPRESENTATION IN PRINCIPAL CITIES

new products

Oil Film Thickness Indicator

Originally manufactured for the Navy, the Mutual Inductance Micrometer is now available to industry. Operating on the mutual inductance principle, the instrument measures the dynamic clearance of a rotating shaft to indicate its eccentricities. It is produced by Minnesota Electronics Corp., 133 E. Santa Anita St., Burbank, Cal.

Shaft-to-bearing clearance is detected by means of six U-shaped probes mounted three on each end of the shaft, 90-deg apart. Variations between these sensing heads and the rotating shaft are compared with a precisely calibrated voltage reference level to indicate reluctances in the air gap between face of the probe and the shaft. Clearance is read on the meter for each probe and converted to mils from a calibration chart. Measurement range is up to 6000 rpm, making it suitable for engine manufacturers, oil companies, and laboratories.

Detergent for Oily Soils

Supersolv, a granular-type detergent, has been developed by Kelite Corp., 1250 N. Main St., Los Angeles 12, Cal., to remove petroleum oils and greases from both solid and porous surfaces. It may be used in cold or hot solutions, in steam or vapor cleaning. The oily soils are removed by displacement. Released vapors are claimed non-toxic, noncorrosive, and non-flammable.

Hose Clamp

For general fastening use, Breeze Corps., Inc., 700 Liberty Ave., Union, N. J., is producing a new time-saving hose clamp—the Aero-Seal Jet, manufactured in noncorrosive stainless steel in a wide size range.

Quick hose attachment is accomplished by pushing the housing of the clamp to a fitting position on its slotted clamp band. A few turns on the screw does the locking. For detachment, the screw is loosened and lifted, and the clamp springs open.

news of our industry

B-L-H Locomotive to Texaco

Delivery of a 25-ton diesel-hydraulic locomotive has been accepted by the Texas Co. from Baldwin-Lima-Hamilton Corp. for use in its Bayonne, N.J. terminal. Equipped with a Cummins diesel rated 225 bhp at 1800 rpm, the locomotive exerts a 12,500-lb tractive effort at 25% adhesion.

Dual-Purpose Gas Turbine

A major contributor to the long-range performing ability of the Martin SeaMaster, the U.S. Navy's new multi-jet attack seaplane, is a newly developed dual-purpose gas turbine auxiliary power plant. Engineered by The Garret Corp.'s AiResearch Div., the self-contained energy source delivers compressed air to start the plane's main engine while simultaneously acting as an electrical power plant.

It marks the first time that an AiResearch turbine of this type (GTCP-85) has been called upon to generate both shaft hp and compressed air at once, or to generate either form of power interchangeably. All of these functions are important to the SeaMaster which may operate thousands of miles away from its base for long periods of time and must therefore carry its own source of pneumatic and electric power.

The compact unit can supply immediate and adequate electrical power for emergency use in takeoff and landing, after which it can be switched off to stand ready for overload or emergency situations. It makes the plane entirely independent of outside power sources when operating out of isolated regions.

Mack Buses to Puerto Rico

Forty additional diesel buses have been ordered by the Puerto Rico Ports Authority to supplement the 50 it delivered in June, Mack Trucks, Inc. announces. The new order brings the total amount placed to more than $1.68 million. The buses are 45-passenger units specially equipped for service in the tropic climate.

news of our industry

Van der Horst Expands

Van der Horst Corp. announces that it has purchased property in Chicago for the establishment of a new plant. An increased demand for its patented Porus-Krome electroplating process in the Midwest is credited by the organization for its new establishment. It now has plants in New York, Texas, and Holland, in addition to licensees in Los Angeles, Baltimore and Minneapolis. Initial installations at the Chicago plant will provide for a 48,000-amp hr plating capacity.

More Train Masters for Reading

Fairbanks, Morse & Co. announces that it has received its third order from the Reading Railroad in the past two years for its Train Master locomotives. The latest order calls for six more of the 2400-hp diesel-electrics at a cost of $1½ million.

The order is part of Reading's $6.8 million expansion and improvement program. The locomotives will be built at F-M's Beloit, Wis. Works.

Holding Power of Joints

The greatest load-holding power of a bolt does not stem from its size, say Russell, Burdsall & Ward, fastener experts of Port Chester, N. Y. Pre-load or residual tension in a tightened bolt means more to assembly strength than the actual strength of the bolt itself. To assure better results at lower cost, designers are urged to take advantage of the fact that a bolt which is torqued to its proper load level in a joint resists a maximum amount of external load without loosening.

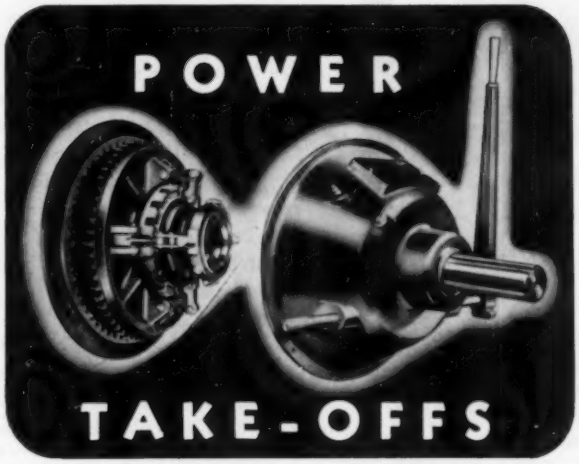
For example, one designer estimated that high-strength bolts at least ½-in diam were needed for truck frames and as a safety factor, used ⅝ in. On the assembly line, however, these bolts were torqued to 100 ft-lb though they needed at least 200 ft-lb for proper residual tension. The ½-in bolt at 100 ft-lb would actually have produced a stronger assembly and at less cost.

In another case, a construction equipment builder found that the bucket on his earthmoving equipment was continually working loose. He kept increasing the size of the bolt, up to 1¼ in, but to no avail. The impact wrench used was supplying far too little torque for this size bolt. By setting the wrench to 350-ft-lb torque, a return to the original ¾-in size bolt was possible.

In still another case, a water gate valve designed to withstand 160 psi used 48 bolts of 1-in diam in a gasket joint holding the bonnet to the valve. The joint leaked badly in testing and the cause was traced to use of an impact wrench built to tighten 2-in bolts because it took less time than a smaller wrench. As a result the bolts were being stretched ½ in. The solution was to tighten the bolts just enough to keep the valve from leaking.

As a rule of thumb, RB&W emphasizes, the more you stress a bolt within its elastic limit, the greater its ability to stay tight and make a strong assembly.

ROCKFORD



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ROLLER BEARINGS *
FINE ADJUSTMENT
ACCURATE BALANCE
S.A.E. DIMENSIONS

* ROCKFORD POWER TAKE-OFFS are equipped with roller bearings of ample proportions to carry the loads to be placed upon them. Provision is made for adjusting the tapered roller bearings that support the shaft. These and the clutch release bearing can be lubricated from outside the housing.

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

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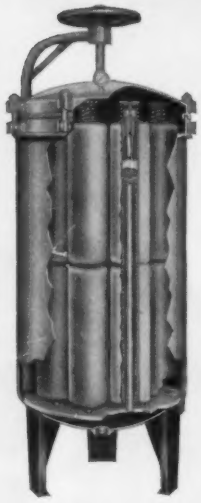
▲ 1301 18th. Avenue, Rockford, Illinois, U.S.A. ▲

CLUTCHES

108
Standard Models



Honan-Crane
Multi-Cartridge Filter

Why 108 models of the same basic filter? *Because each oil filter application creates individual problems.* Scores of variable factors are involved: type of oil, additives, oil viscosity and temperature, flow rate, capacity, space available, nature and degree of contamination, type of heating required, and many more. *All* of these factors must be considered in selecting the proper filtration unit.

Honan-Crane Multi-Cartridge Filters are available in 108 models, ten sizes, and with six different types of interchangeable cartridges, each designed to do a special filtering job. Thus, no matter how unusual or difficult the application, you get a filter exactly suited to your requirements . . . and readily adaptable to *changing* requirements.

The same wide choice of models is also offered in Honan-Crane Bulk Refill and Full Flow type Oil Filters. Custom filtration performance is *standard* with Honan-Crane.

Write for three 8-page Equipment Bulletins:

No. 101—Full Flow Filters

No. 201—Multi-Cartridge Filters

No. 301—Bulk Refill Filters

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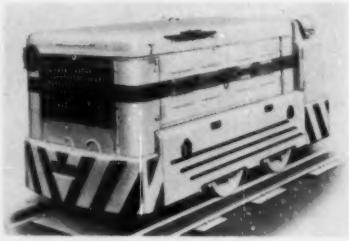
news of our industry



OK Diesel Mine Locomotive

The U.S. Bureau of Mines has approved the new Plymouth Model FMD-22 locomotive under Schedule 22. Power for this locomotive is furnished by a 4-cyl Hercules Model DOOD diesel, rated 48 hp at 2200 rpm for this particular coal-mining application.

Schedule 22, established by the bureau to cover the safe operation of diesel-powered equipment in underground coal mining, has very strict requirements. These insure safe operating conditions in relation to temperatures, exhaust gases, and explosive hazards. To illustrate the high standards established, Hercules states that it was 6½ years before any American manufacturer developed a design which could meet the rigid requirements, and the "first design to be approved was also powered by a Hercules diesel engine of a different size."

Chicago Orders GMCs

A new field of diesel truck application has been introduced by the city of Chicago with its purchase order for 75 GMC trucks for its trash and garbage collection service. A. S. McCoy, fleet manager for the General Motors division, indicates that the city ordered the units after keeping performance records on three trial trucks in its operation for three years.

This is the first major city in the world, he adds, to place a large order for diesel-powered trucks for this type of work. They are DF66-47A cab-over-engine models, powered by 4-71 diesels developing 150 hp. The trucks will work as much as 24 hours a day, operating under severe conditions in the dumping areas. They are equipped with 20-yd capacity bodies.

What Do You Know!

(*Answers to Questions on Page* 52)

1. Correct answer is "b". Blackening of the oil shows that the dispersive additives in the oil are doing their job. This colloidal material, fuel soots, and other carbonaceous material is too small to be harmful and is suspended until caught by filters or oil is dumped. See the article on Page 46.

2. Correct answer is "c". Some 2-cycle engines are very easy to lubricate and are not as hard on lube oils as some 4-cycle types. See article mentioned above.

3. This is a tricky one. "b" would generally be correct. Two filters are not necessarily better than one if one is doing a good job. Increase in oil's service life (hp-hr) is offset by increased oil capacity (in filter case). See article above.

4. Correct answer is "b". Slip rings and brushes are still needed for excitation (except for a few permanent magnet field types). Rapid voltage buildup depends on rate of drive. For discussion, see Page 53.

5. Correct answer is "b". Elimination of water in fuel generally improves operation but won't take care of water vapors produced by combustion or water condensate. See Page 50.

6. For No. 6 fuels, only "b", "e", and "g" are specified. "f" is added for No. 5 fuel. See Page 50.

7. Correct answer is "b". While it is desirable to use lighter grades, it's not necessarily true that a heavier grade will not make a good fuel. A low-gravity fuel of low viscosity could be a good fuel provided its other characteristics are satisfactory. See article, Page 50.

8. Correct answer is "b". Unless water from which all hardness has been removed is otherwise treated, it will have corrosive action on the cooling system. See Page 58.

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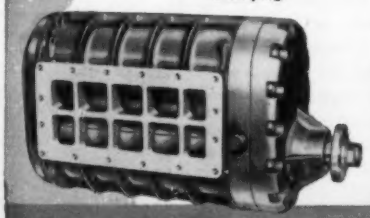

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news of our industry

Cat Redesigns DW15 Tractor

Caterpillar Tractor Co. has announced that its DW15 tractor, just completing its first year in the field, has undergone major design change. Designated the new DW15 (Series C), it will feature a 186-hp, 5⅛-in by 6½-in engine for greater service. A new transmission case, to give positive lubrication under adverse operating conditions, is also included in the change. No. 27 cable control will be standard equipment.

Alco Ups Rail Diesel Output

A marked increase in its railroad supply business has been reported by Alco Products, Inc. It has shipped almost as many diesel locomotives in the first half of 1955 as it built in all of 1954. This upward trend is also reflected in the company's backlog of locomotives on order which has increased fourfold as compared with the first half of 1954. Export business is also said to have picked up sharply.

Savannah Rail Orders Baldwin

Scheduled to be delivered to Savannah & Atlanta Railway is a 1600-hp diesel-electric all-service locomotive, Model AS-416, which is suitable for general switching or high-speed mainline service. The Baldwin-Lima-Hamilton locomotive will incorporate an 8-cyl supercharged diesel and four of its six axles will be motorized to produce 44,000-lb tractive effort at 25% adhesion.

Federal-Mogul Merger Official

The formal merging of Bower Roller Bearing Co. into Federal-Mogul Corp. has been approved by stockholders of the two organizations. Bower will now be operated as a division of the new Federal-Mogul-Bower Bearings, Inc.

The merger was described as a natural move for both companies. Though both are in the bearings business, their products are not competitive. Federal's principal products are sleeve and ball bearings and bushings; Bower makes straight and tapered roller bearings.

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organizational news

New Executive Engineer
for Elliott Co. is Captain Max Schreiner (USN retired). He will be responsible for all engineering of the company's turbine, compressor, supercharger, and general apparatus divisions.

Captain Max Schreiner

John H. Seanor

Appointed Sales Director
at Kent-Moore Organization, Inc., John H. Seanor has left Stewart-Warner Corp. where he has been for 18 years. He was in charge of original equipment sales for the last five years.

Chicago Branch Manager
of Enterprise Engine and Machinery Co., General Metals Corp. subsidiary, is now Stuart F. Atsatt who has been with the company for six years, the last two as district manager in Minneapolis.

Stuart F. Atsatt

T. E. Snyder

Latest Addition at Exide
Industrial Div., The Electric Storage Battery Co., is T. E. Snyder who has been placed as advertising and sales promotion manager to take over the duties temporarily assigned to E. J. Fitzmaurice, Jr., sales engineering manager of the division.

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organizational news

A Manager and New Distributors have been appointed by Cummins Engine Co., Inc. B. C. Sears has been relocated as Great Lakes manager from his post as Rocky Mt. manager. The entire territory of Alaska has been assigned to the new Cummins Diesel Sales of Alaska, Inc., under R. B. Newell, former vice president at Cummins Diesel Sales of Washington. And Cummins Diesel Michigan, Inc., under L. W. Childs, has been formed to operate in Michigan and northern Ohio.

B. C. Sears

Ronald C. Beckett

Oil Filtration Specialist
Ronald C. Beckett, has joined Michiana Products Corp. as chief engineer of its Oil Filter Div. He leaves Walker Mfg. Co. where he was chief engineer.

Appointed Sales Manager
for the central district of Houdaille-Hershey of Indiana, Inc. is Walter J. Holder. Formerly Chicago district manager, his new post will encompass northern Illinois, Indiana, Ohio, Kentucky, Michigan, Wisconsin, Iowa, and North and South Dakota.

Walter J. Holder

William Webster

Acting Manager
at the Chicago office of Federal-Mogul Corp.'s Service Div. will be William Webster, to succeed Walter T. Camp who is now in a sales management position at Bearings Co. of America Div. With F-M since 1949, Mr. Webster's most recent assignment has been sales development supervisor.

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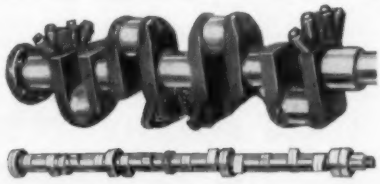

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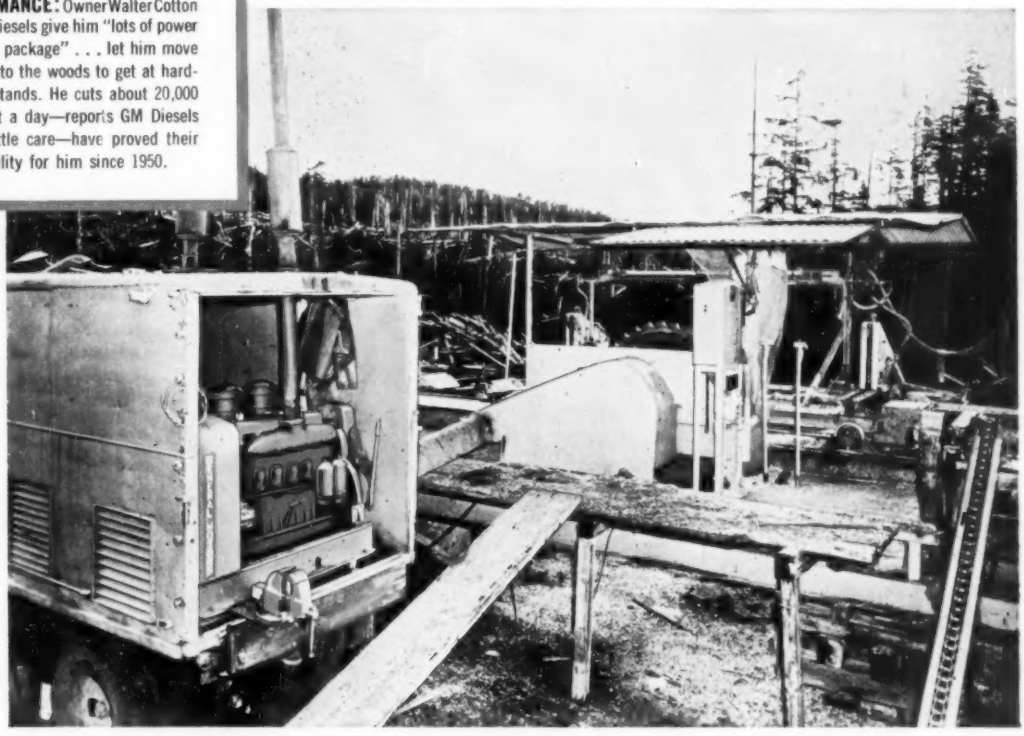
GM DIESEL
CASE HISTORY No. IA6-111

USER: Cotton Brothers, Spanaway, Washington.

INSTALLATION: Two GM "6-71" Diesels. #1 engine operates head rig. #2 Diesel drives 100-KW generator set supplying power for log haul and cut-off saw, edger, blowers, air compressor.

PERFORMANCE: Owner Walter Cotton says GM Diesels give him "lots of power in a small package" . . . let him move his mill into the woods to get at hard-to-reach stands. He cuts about 20,000 board feet a day—reports GM Diesels require little care—have proved their dependability for him since 1950.

"Lots of Power in a small package"



You'll find a General Motors 2-cycle Diesel delivers more usable power for its size and weight than any other Diesel.

To lumbermen that means faster, easier, cheaper moves—means reaching hard-to-get-at stands impossible to reach with big, bulky power plants.

But a GM 2-cycle Diesel gives you more than portability. Its 2-cycle operation delivers power at every piston downstroke—twice as many strokes per crankshaft revolution as a 4-cycle Diesel. That means quicker response to governor controls—steadier, more uniform saw operation—faster recovery when the blade hits tough going.

And with a GM Diesel you'll burn fewer gallons of safer, cheaper fuel—get push-button starts even in damp, cold weather. You won't need service often but, when you do, you'll get fast action and quick delivery of low-cost parts from your local GM Diesel distributor. Call him today for details on GM Diesel power in all your logging and lumbering equipment.

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Demands upon the lubricant in stationary industrial engines are increasing. More severe operating conditions caused by heavier loads, new engine designs and the use of economy fuels pose difficult lubrication problems not met by conventional oils. Standard Oil Company introduces a lubricant specifically designed to meet these problems—STANODIESEL Oil M.

STANODIESEL OIL M

STANODIESEL Oil M meets or exceeds the requirements of a lubricant for stationary industrial engines. Here's why:

STANODIESEL Oil M is refined from the highest quality base stock. It has superior stability.

Special additives are blended with this STANODIESEL Oil M base stock. An oxidation inhibitor prevents unwanted increases in oil viscosity and prevents corrosion of bearings. The action of detergent-dispersant additives keeps crankcase, pistons, cylinder walls and other parts clean. Contaminants are kept in suspension and are prevented from depositing. An anti-foam agent makes this oil suitable for use in hydraulic governors. A wetting agent increases the oil's ability to reach and maintain a film on such highly stressed parts as cams and cam followers.

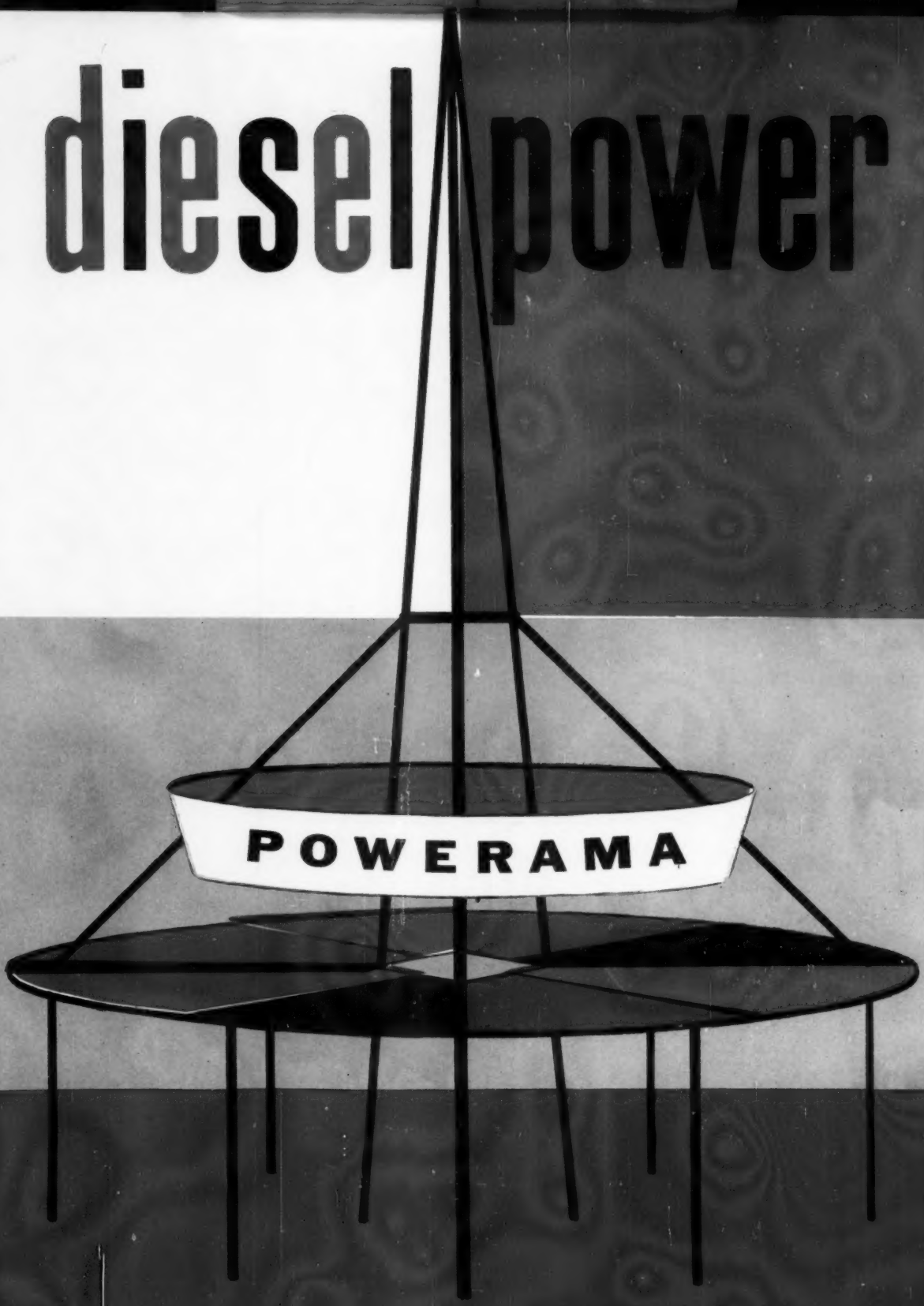
Use of STANODIESEL Oil M means this: less engine deposits, less ring and cylinder wear. Less spark plug fouling when used in gas engines. Eliminates fuel injector and pump sticking caused by deposits on the injector barrel and plunger when fuel and lubricating oil commingle.

You need to know about STANODIESEL Oil M. In the Midwest, call your nearby Standard Oil lubrication specialist. You will receive the information promptly. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD

STANDARD OIL COMPANY (Indiana)

diesel power



GM
GENERAL MOTORS
DIESEL
POWER

TEXACO

An Open Letter to GM...

CONGRATULATIONS on your dramatic Powerama and the magnificent diesel production record — one hundred million horsepower! — which it celebrates.

Over the years that this achievement has been in the making, we have been privileged to supply Texaco Lubricants and Lubrication Engineering Service to the great majority of GM plants in the United States.

We are proud that the quality of Texaco products and service has justified their continued use. And we are proud, too, that so many of your customers also rely on Texaco to keep their GM Diesels functioning efficiently. For it is a fact that—

For over 20 years, more stationary diesel horsepower in the United States has been lubricated with Texaco than with any other brand.

We look forward to serving General Motors and its customers throughout the hundreds of millions of GM Diesel horsepower that will be produced in the years to come.

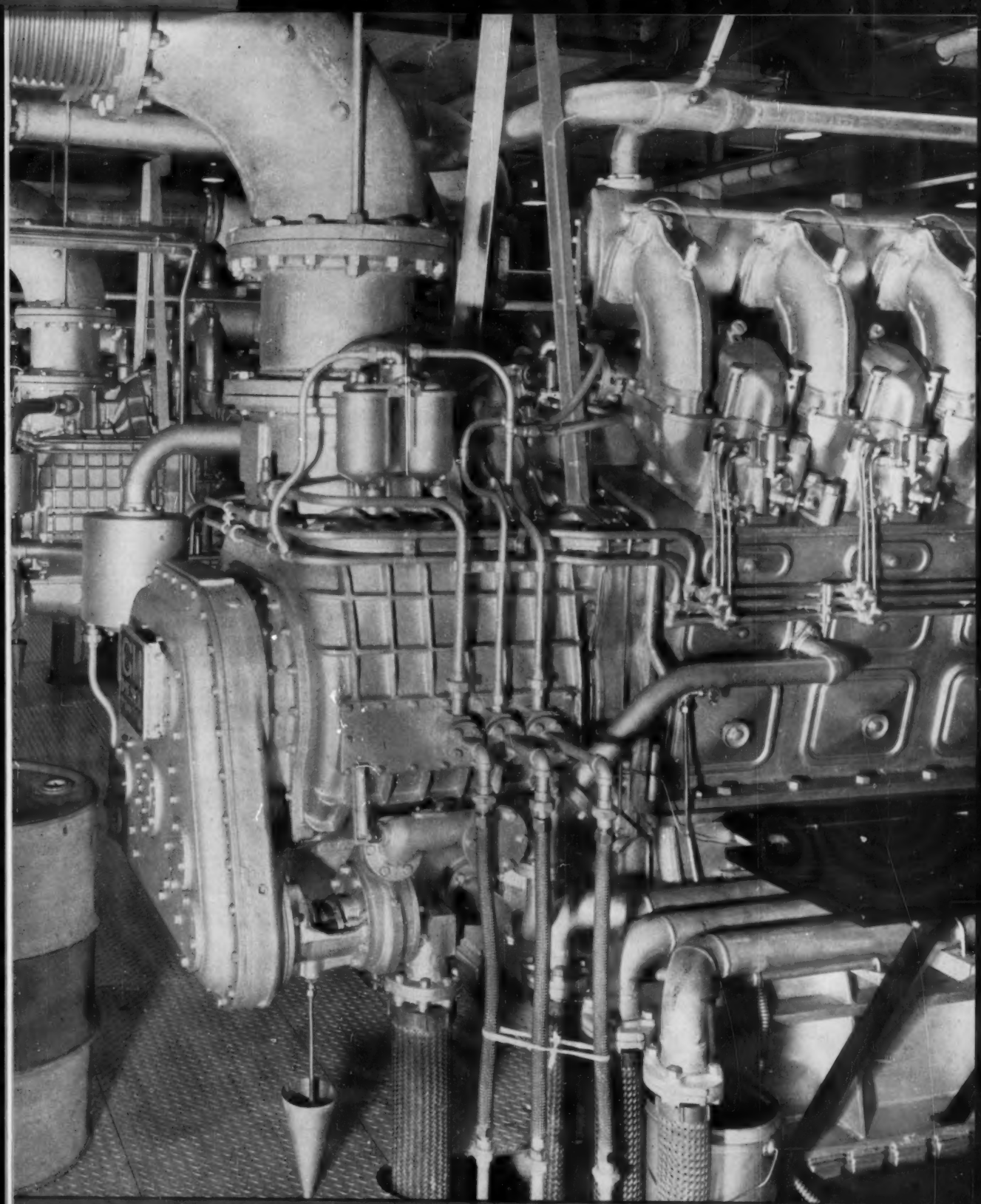
THE TEXAS COMPANY

IN ALL 48 STATES

TUNE IN:
TEXACO STAR THEATER
starring
JIMMY DURANTE
on television...
Saturday nights, NBC.

TEXACO

TEXACO



URSA OILS

FOR ALL DIESEL, GAS
AND DUAL-FUEL ENGINES

ELECTRIC POWER

DELCO-REMY HEAVY-DUTY A.C. GENERATORS

Delco-Remy A.C. generators with companion regulators and rectifiers are the hearts of 12-volt A.C.-D.C. electrical systems designed specifically for modern Diesel buses with fluorescent lighting and extra-heavy electrical loads.

Desirable performance characteristics include cut-in at low generator rpm . . . maximum outputs (ranging up to 180 amperes) at low to medium speeds. The new generators supply not only alternating current for fluorescent lights but also ample direct current for the heaviest electrical loads coupled with lengthy engine-at-idle periods.

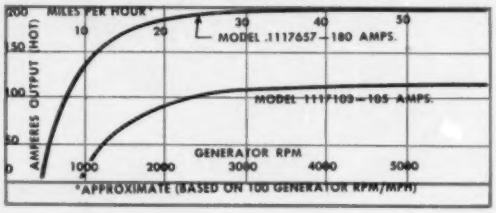
Impressive features of the new generators are their light weight, very high output capacity, and ability to operate over a wide speed range with greatest efficiency. Specify Delco-Remy electrical equipment on your new buses.

A.C. GENERATOR PERFORMANCE DATA (HOT)

Model	Volts	Cut-in RPM	Curb Idle Amperes*	Maximum Amperes	Power Watts SAE	Recommended For
1117103	12	960	5	105	1575	All speeds.
1117657	12	550	130	180	2700	All speeds.
1117062-3-4	6	750	38	90	720	All speeds.

*APPROXIMATE (BASED ON 1000 GENERATOR RPM)

A.C. GENERATOR OUTPUT CURVES (HOT)



DELCO-REMY HEAVY-DUTY D.C. SPLIT-FIELD GENERATOR (120-Ampere Output Capacity)

The Delco-Remy 12-volt split-field generator and its companion regulator are rugged and dependable—designed to meet the needs of Diesel transit buses having increased electrical loads coupled with a high percentage of engine idling time.

Desirable performance characteristics include low cut-in, maximum output at less than 1,000 generator rpm. Note performance table at right.

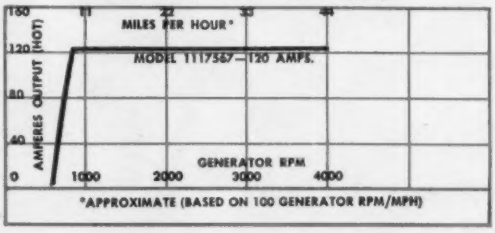
Operating benefits include reduced battery cycling, long battery life, and a simplified electrical system with sustained voltage—at no sacrifice in ruggedness or dependability.

D.C. GENERATOR PERFORMANCE DATA (HOT)

Model	Volts	Cut-in RPM	Curb Idle Amperes*	Maximum Amperes	Power Watts SAE	Recommended For
1117567	12	560	120	120	1800	Low speed & idling.

*APPROXIMATE (BASED ON 1000 GENERATOR RPM)

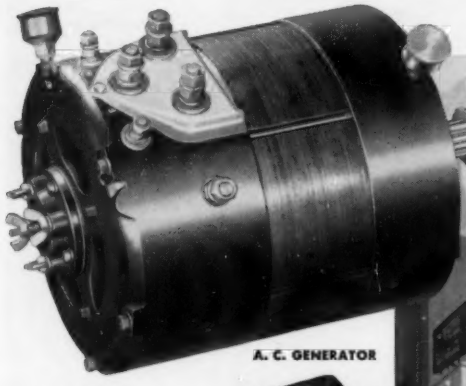
D.C. GENERATOR OUTPUT CURVES (HOT)



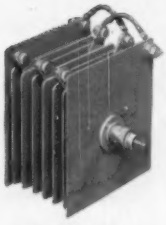
Delco-Remy
ELECTRICAL SYSTEMS

DELCO-REMY • DIVISION OF GENERAL MOTORS • ANDERSON, INDIANA

right for the job



A. C. GENERATOR



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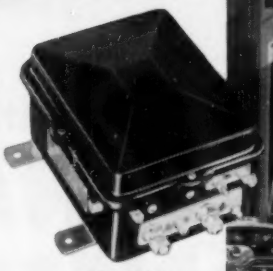
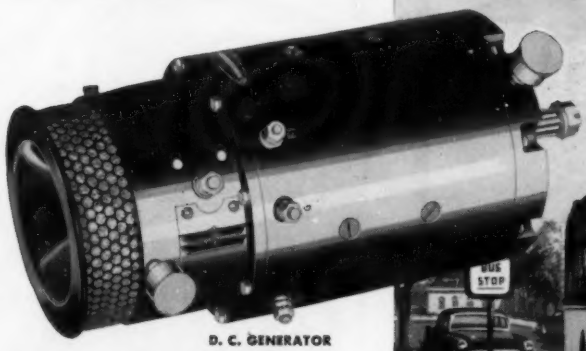
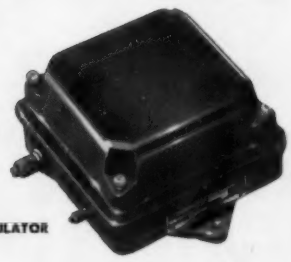


REGULATOR



D. C. GENERATOR



REGULATOR

WHEREVER WHEELS TURN OR PROPELLERS SPIN

MORE POWER FOR DIESELS... with VANASIL PISTONS

"Vanasil Pistons Perfect after 86,226 Miles — Hauling 80 to 100 Ton Payloads"

TRUCK 23—A new set of Vanasil Pistons put in Cummins 300 diesel engine. Power increase permitted using ½ gear higher. Fuel consumption—much better. Oil consumption—good. Motor overhauled after 86,226 miles—"miking" the pistons showed *no wear* and *ring grooves were perfect.*

TRUCK 18 (in photo above)—Has rebuilt Cummins engine from truck 23, with *same Vanasil pistons* and new set of sleeves and rings. Now has several thousand more miles, hauling 80 to 100 ton loads of logs on private roads. This is a Cummins 300 in a Kenworth truck.

OPERATOR'S COMMENTS:

- **Smooth, quiet motor. If you walk away 15 feet, turn your back, you cannot tell if it's a diesel or gas engine running.**
- **Acceleration better for changing gears—more power for steep grades.**
- **Can make better time than other trucks. Truck 23, hauling heaviest load permitted by California laws, regularly saved from ½ hr. to 1 hr. on 115-120 mile run from loading point to Bay area.**
- **Drivers like to drive this "Vanasil" truck.**

(CAREFUL COST RECORDS are kept by this operator of 26 diesel powered trucks which handle 300,000 feet of logs and 60,000 board feet of lumber each working day.)

TRY VANASIL PISTONS!

You'll handle bigger payloads faster. You'll cut down on fuel and oil costs. You'll get long, l-o-n-g, L-O-N-G piston wear and fewer overhauls. Write or phone for circular—let us quote you on Vanasil pistons.

GILLETT & EATON, INC.

846 Doughty St. • Phone 6201 • Lake City, Minn. • Established 1868

VANASIL Piston Warehouse Stocks

CALIFORNIA—
Automotive & Industrial Whse. Co., 1341 So. Hope St., Los Angeles 15
Piston Supply Warehouse, 2768 Grove St., Oakland 12

COLORADO—
Denver Bearing Co., 780 Lincoln St., Denver 2

NEW YORK—
Bethlehem Equipment Co., 109 W. 64th St., New York 23

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diesel power

Established in 1923 Vol. 33, No. 9, Part 2 September, 1955

In This Issue

An Introduction to Powerama 28

Behind the Powerama and symbolized by it is the diesel industry, with its daily impact on our national economy. In the succeeding pages, the activities of GM's Engine Group, plus the GMC Truck & Coach Division, all participants in the Powerama, are outlined along with their contributions toward the building of a bigger and better industry.

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Research Laboratories Division 72

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Cable Address: Dieselpub — New York

EATON
Valves and Bolts
FOR DIESEL ENGINES

Eaton Diesel engine parts combine the experience of many years as suppliers to the Diesel engine industry with the most modern precision production facilities—plus a thorough understanding of the problems peculiar to the Diesel engine field.

Eaton engineers will welcome the opportunity to discuss the application of Eaton Valves and Bolts to your engines.

EATON

VALVE DIVISION

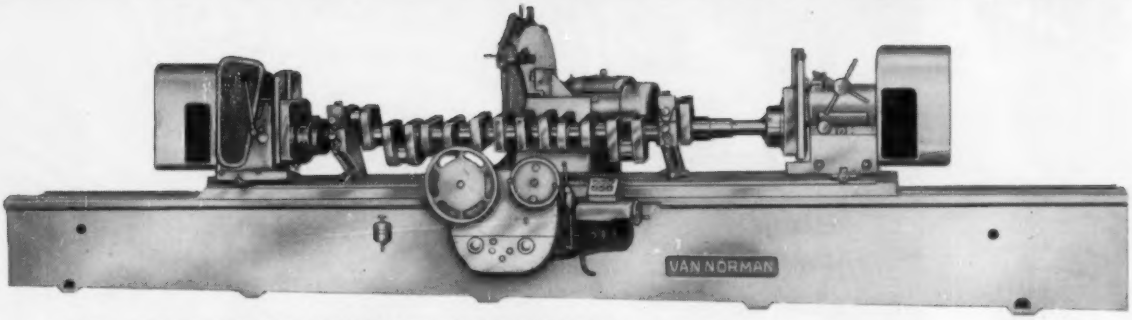
MANUFACTURING COMPANY

9771 FRENCH ROAD • DETROIT 13, MICHIGAN

General Offices: CLEVELAND, OHIO

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

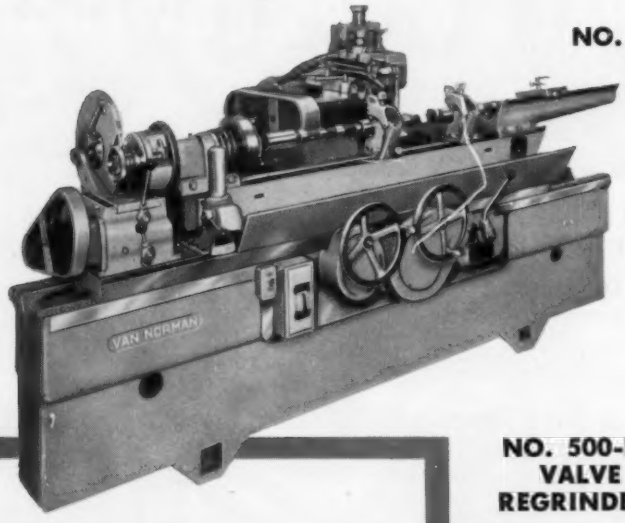
Keep Your Diesels up to Full Power with VAN NORMAN Machines



NO. 111-ELW CRANKSHAFT REGRINDER:

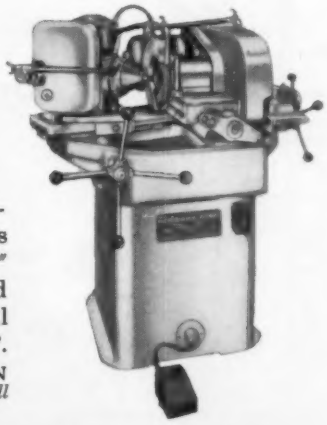
One of 8 models of machines available for shafts up to 167″ long. Many exclusive Van Norman engineering features assure top speed and accuracy previously unobtainable in crankshaft regrinding.

NO. 253



CAMSHAFT REGRINDER:

Quickly and accurately regrinds camshafts. Distance between centers: 82″. Maximum diameter: 9″ swing.



NO. 500-RB VALVE REGRINDER:

This heavy-duty machine takes valves from ¼″ to 1¼″ stem diameter, and up to 5″ face, all angles from 15 to 75°.

Write VAN NORMAN *for the full story on all these machines.*

Other VAN NORMAN Machines:

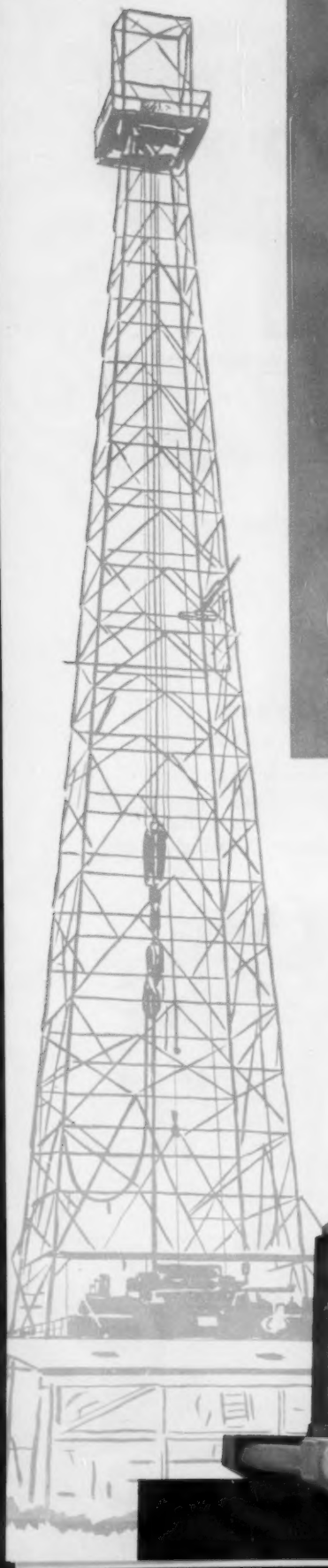
Cylinder Boring Bars, diameters 1.90″ to 9.05″
Cylinder Honing Machines, Automatic
Automatic Wet Surface Grinder for Cylinder Heads, Block Tops, Manifolds
Automatic Piston Grinders
Con-rod Reconditioning Machines
Clutch Pressure-Plate Grinders

"It Pays to Van Normanize"

VAN NORMAN CO.

Springfield 7, Massachusetts

WORLD'S LARGEST MANUFACTURER OF HEAVY-DUTY AUTOMOTIVE SERVICE MACHINES



On Shovels like this and other construction and earth moving equipment Woodward Governors are used to control the diesel engines, the torque converters or both.

WOODWARD GOVERNORS
ATTEND
GENERAL MOTORS POWERAMA

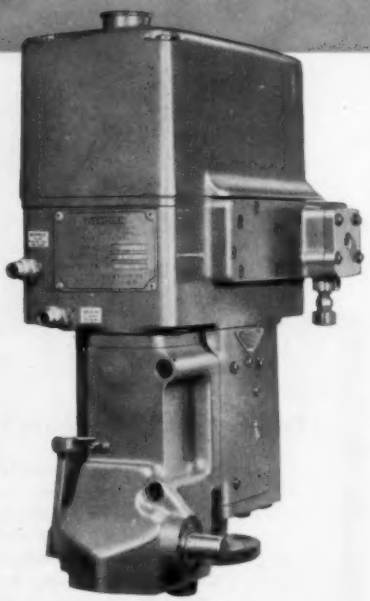
There is a Woodward Governor on every Locomotive built by General Motors. A few other General Motors Applications are shown here.

Woodward Governors are used on the following General Motors Equipment:

ALLISON DIVISION
Torque Converters

DETROIT DIESEL ENGINE DIVISION
Engines

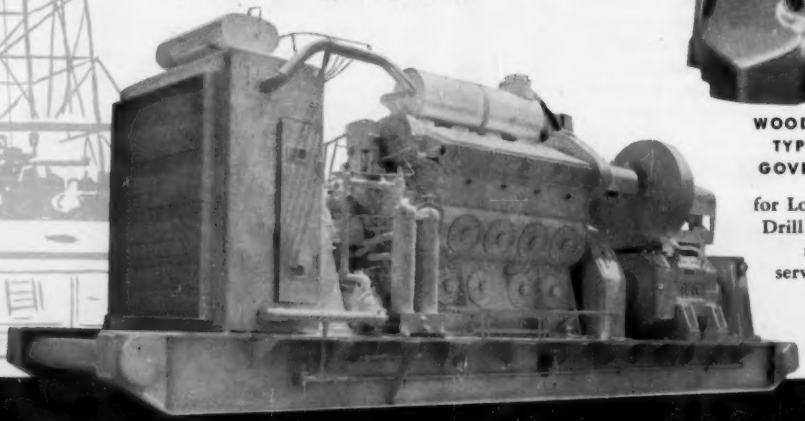
ELECTRO-MOTIVE DIVISION
Diesel Locomotives, Electro-Mobile and Drill Rig Power Units

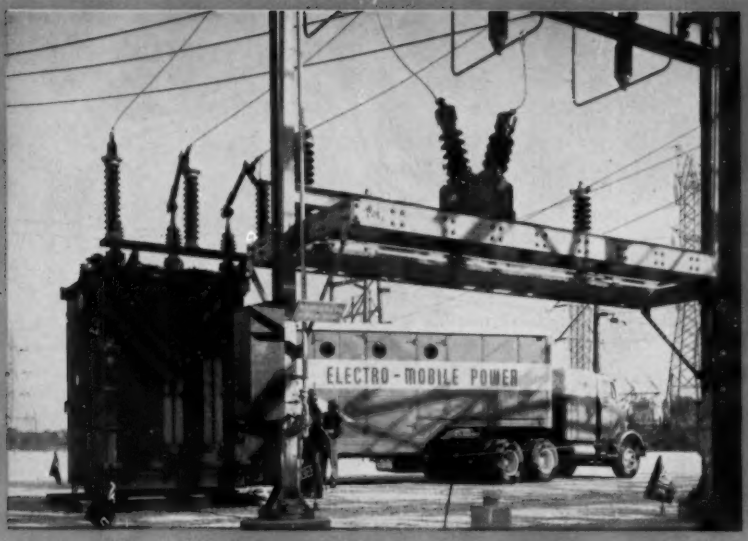


WOODWARD TYPE PG GOVERNOR

for Locomotive engines, Drill Rig engines and many other special service applications.

Electro-Motive's new Drill Rig Power Unit controlled by a Woodward type PG governor.





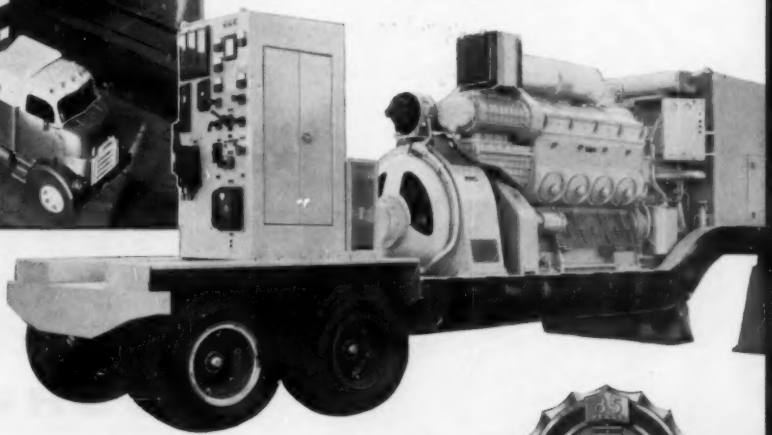
New Electro-Mobile Power Unit operated automatically from remote control station. A Woodward type UG8 governor controls the prime mover.

All Woodward Governors are engineered to the specific requirements of the particular prime mover they control. They may be totally new designs or they may be modifications of Governors built for similar applications. In either case every Woodward Governor is engineered to meet its specific job requirements.

WOODWARD TYPE UG8 GOVERNOR

for electric generator service applications.

Electro-Mobile Power Units . . . mobile generating stations mounted on railroad cars and highway trailers. Governed by Woodward type UG8 governors.



Electro-Mobile Power Unit with trailer body removed showing control panel.

WOODWARD GOVERNOR COMPANY

ROCKFORD, ILLINOIS

WORLD'S OLDEST AND LARGEST MANUFACTURER OF HYDRAULIC GOVERNORS FOR PRIME MOVERS

They Help Keep G-M Diesels

"On the Go!"

In developing brushes used on many Electro-Motive diesel locomotives and other power equipment, Stackpole has been privileged to play a small, but highly specialized part in paving the way for today's spectacle of "Powerama."

THEY'RE KIND TO COMMUTATORS!

STACKPOLE

diesel-electric

BRUSHES

STACKPOLE CARBON COMPANY, ***St. Marys, Pa.***

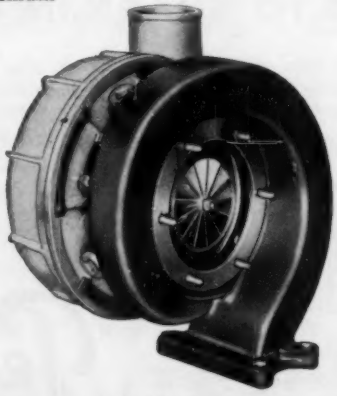
EXHAUST DRIVEN TURBO CHARGERS

By

SCHWITZER -CUMMINS

Backgrounded by the experience of 25 years designing and building superchargers for a great variety of engines, Schwitzer-Cummins turbochargers offer the proven best in the art of supercharging and how to apply it. If you wish to turbocharge your engine, Schwitzer-Cummins turbochargers will provide the maximum in horsepower increase with minimum weight addition and many unique features of design. 40 to 400 brake horsepower, naturally aspirated. Inherent in all models are smaller size—lighter weight—higher efficiency—extremely low inertia of rotating parts promoting immediate response to load or speed changes—unusual adaptability—simple, inexpensive horizontal or vertical mounting—minimum maintenance.

MARINE TYPE
MODEL D 5SM TURBOCHARGER



AUTOMOTIVE TYPE
MODEL D 5U TURBOCHARGER

OTHER PRODUCTS

- SUPERCHARGERS POSITIVE DISPLACEMENT
- COOLING FANS
- OIL PUMPS—WATER PUMPS
- CRANKSHAFT VIBRATION DAMPERS
- AUTOMATIC SHAFT SEALS
- PUMPS FOR AUTOMATIC TRANSMISSIONS AND POWER STEERING
- AIR STARTING MOTORS
- THERMOSTATICALLY CONTROLLED FAN DRIVES

Air Starting Motors and Thermostatically Controlled Fan Drives manufactured for and sold exclusively by the Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio

SCHWITZER-CUMMINS COMPANY
1125 MASSACHUSETTS AVENUE
INDIANAPOLIS 7, INDIANA, U.S.A.

PEDRICK IS PROUD TO SHARE IN GM PIONEERING

Over all the years that General Motors has been selling diesel engines, the Wilkening Manufacturing Co. has been privileged to make piston rings for this great corporation. One of the earliest ring designs for G.M. diesels was the flexible, conformable oil ring shown above. It was for the 71 series.

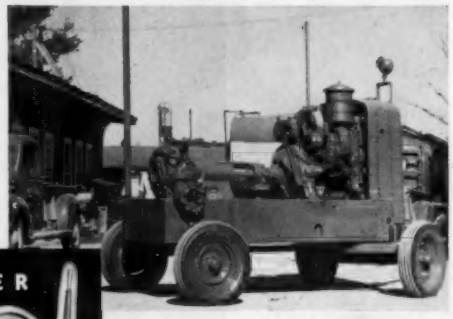
Today, Pedrick piston rings are made for many of the great diesel and natural gas engines which contribute so much in dependable, economical power to the industrial economy of America and the world.

Wilkening Manufacturing Co., which makes Pedrick piston rings, can claim a number of important "firsts" in the development of better and better rings for diesel engines. Among these "firsts" are Complete Engineered Sets, Conformable Oil Rings, Taper-Face Twisted Compression Rings, Heat-Shaping, Double-Disk Grinding, Coatings, Light-Tightness. All these features contribute to the kind of performance and life which every engine builder and operator wants. WILKENING MANUFACTURING CO., Philadelphia 42 and Toronto 2.

Pedrick HEAT-SHAPED PISTON RINGS

PEDRICK PRECISIONEERING KEEPS PEDRICK FIRST

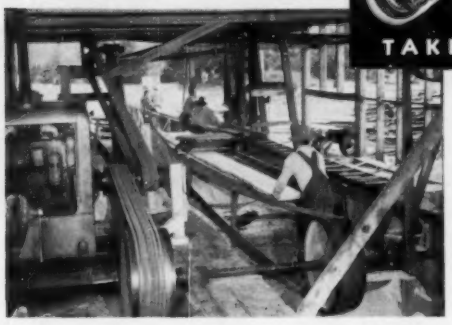
ROCKFORD

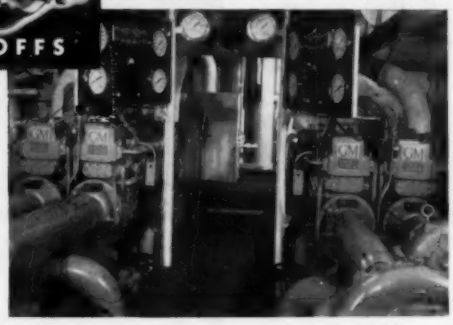


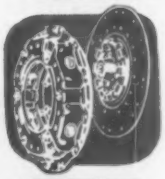
POWER TAKE-OFFS

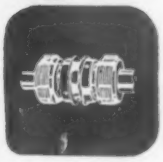
ROAD & CONSTRUCTION
LUMBERING & MINING

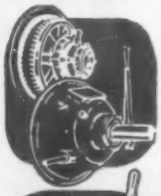
OIL FIELD & IRRIGATION
INDUSTRIAL & TRANSPORT

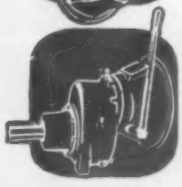












DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS

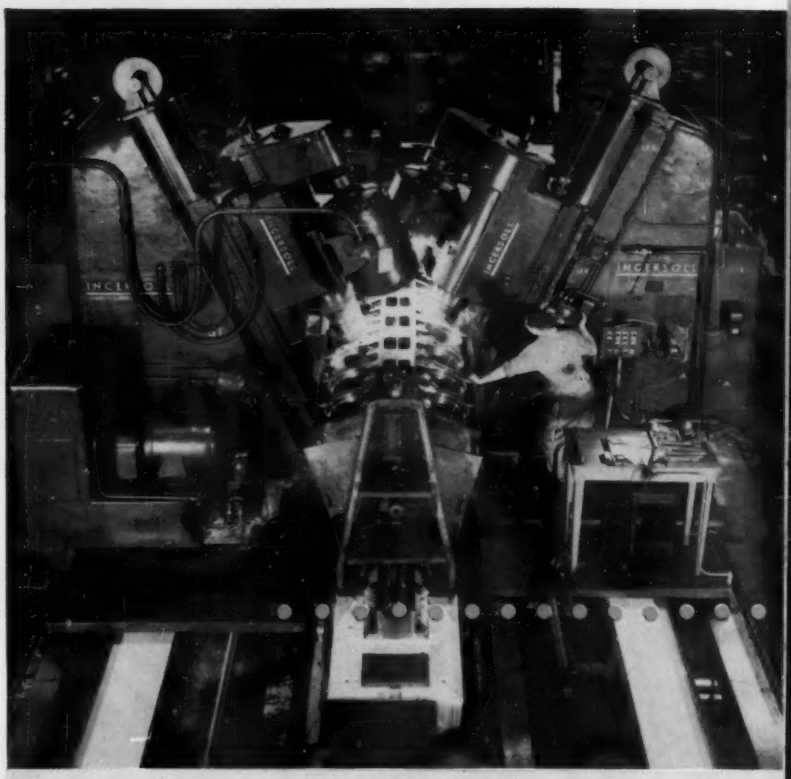
POWERAMA

Lake Shore Drive South of Soldier Field in Chicago --- Aug. 31st thru Sept. 25th

ROCHFORD POWER TAKE-OFFS and CLUTCHES are used on Detroit Diesel Engine Division's *Power Units.* See several of them along with many fascinating exhibits in the General Motors POWERAMA. We urge all diesel engine users to visit this 26 day "World's Fair of Power" and see the dramatic contributions these machines are making toward America's industrial progress.

ROCKFORD
Clutch Division
BORG-WARNER
1301 Eighteenth St., Rockford, Ill.

CLUTCHES

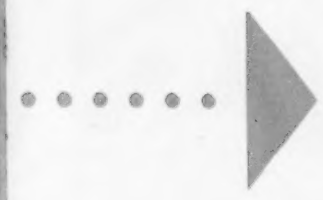


Gulf Quality Lubricants safeguard costly equipment like this in the Electro-Motive Plant. Leading Gulf brands used here include Gulf Harmony Oil for hydraulic systems; Gulf Gem Oil for spindles; Gulfcrest Oil for turbines; Gulf Anti-Friction Grease, Gulf Precision Grease; Gulf HM Grease, Gulf High Pressure Grease, and Gulf Plastic Petroleum B for various grease lubricating applications.

The Chesapeake & Ohio is one of scores of railroads that use Gulf Dieselmotive Oil for better lubrication of their Diesel locomotives and lower maintenance costs.

Gulf Quality Lubricants

help maintain production of Electro-Motive Diesels



in the plant

and contribute to top performance

on the rails

The Electro-Motive Division of General Motors at LaGrange, Illinois, has invested millions of dollars in equipment to produce the famous EMD Diesel locomotives for the nation's railroads. And they make sure that this huge investment is well protected by proper lubrication—largely with Gulf Quality Lubricating Oils and Greases.

When you see an EMD locomotive on the rails, there is a good chance it's lubricated with Gulf Dieselmotive Oil, the modern Diesel locomotive lubricant. This outstanding oil is used by practically every leading railroad in Gulf's marketing territory.

For specific lubrication information for your equipment—and for expert help on any problem that involves lubricants or lubrication—call in a Gulf Sales Engineer. He can help you discover opportunities for important savings in operating and maintenance costs. Write, wire or phone your nearest Gulf office.

GULF OIL CORPORATION • GULF REFINING COMPANY

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THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

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Perkins

DIESEL ENGINES

IN THE FOLLOWING APPLICATIONS

IN USE IN **143** COUNTRIES

F. PERKINS (CANADA) LTD., 237/239 McRAE DRIVE, LEASIDE, TORONTO 17, ONTARIO

Tel: 4348/9. *Cables: Perkoil, Toronto*

Perkins

AUSTRALIA: Perkins Diesel (O'seas) Pty. Ltd., Princes Highway, Dandenong, Victoria. Tel: 1377/8 Cables: Diesel, Dandenong.

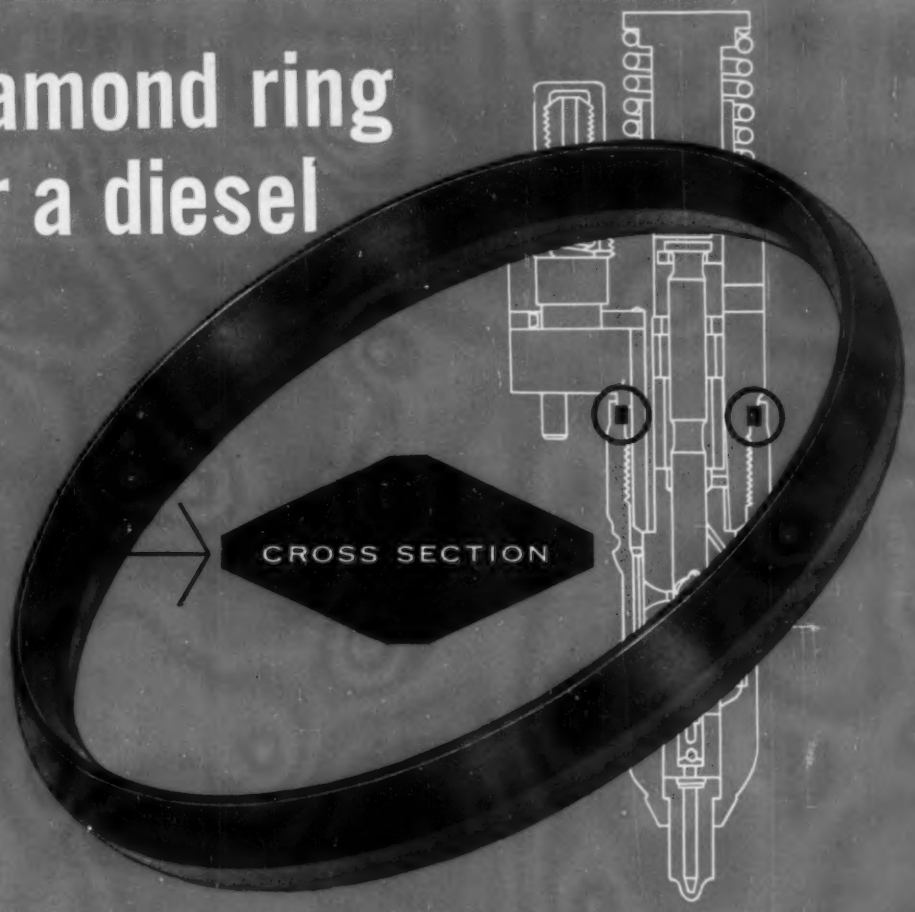
S. AFRICA: F. Perkins (S.A.) (Pty.) Ltd., P.O. Box 9951, 156 Main Reef Road, Johannesburg. Tel: 24-3087. Cables: Perkoil, Jo'burg.

FRANCE: Societe Francaise des Moteurs F. Perkins, 2, Rue Catulle-Mendes, Paris 17e. Tel: GALvani 67-35. Cables: Perkoil, Paris.

HIGH QUALITY **DIESELS** *. . . FOR AUTOMOTIVE, AGRICULTURAL, INDUSTRIAL & MARINE APPLICATIONS*

F. PERKINS LTD. PETERBOROUGH, ENGLAND

Diamond ring for a diesel



ELIMINATES INJECTION NOZZLE LEAKS

Crankcase dilution can be a big headache. But not for one of the leading Diesel manufacturers. They knew that the right injection nozzle seal would cure a major cause . . . and came to C/R Sirvene engineers for help. C/R manufactured this Sirvene (synthetic rubber) part to extremely critical dimensions and physical properties to match the equally precise dimensions of the assembly. Result: no more leakage. When you need a unique pliable part, produced with precision quality, you need C/R Sirvene. Write us for your copy of "Engineering with Sirvene."

C/R SIRVENE
SCIENTIFICALLY COMPOUNDED ELASTOMERS

CHICAGO RAWHIDE MANUFACTURING COMPANY

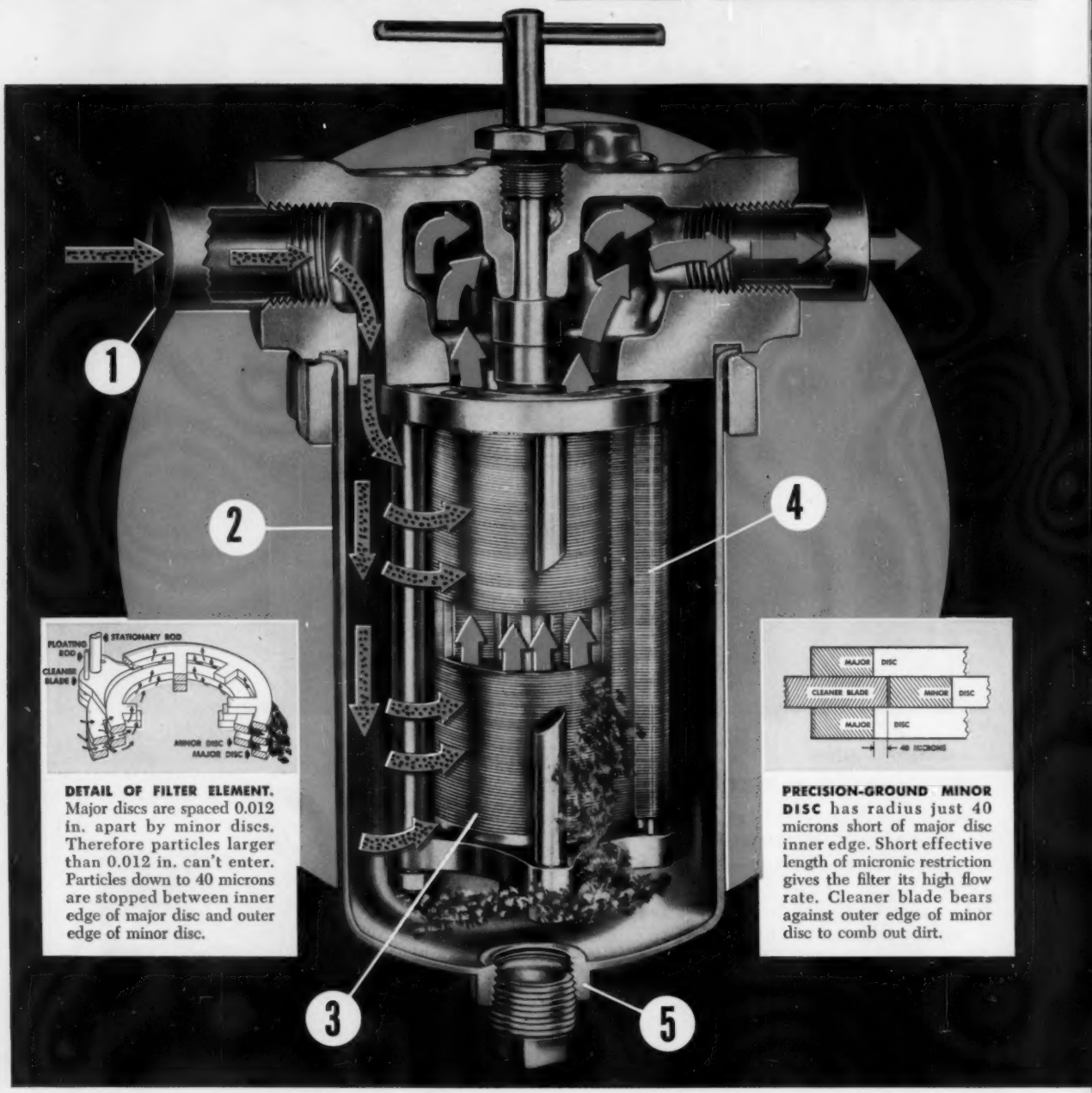
1301 Elston Avenue SIRVENE DIVISION Chicago 22, Illinois

IN CANADA: MANUFACTURED AND DISTRIBUTED BY SUPER OIL SEAL MFG. CO., LTD., HAMILTON, ONT.

Other **C/R** *products*

OIL SEALS: Shaft and end face seals for all types of lubricant retention and dirt exclusion • CONPOR: Controlled porosity mechanical leather packings and other sealing products • SIRVIS: Mechanical leather boots, gaskets, packings and related products.

New CUNO 40-micron



DETAIL OF FILTER ELEMENT. Major discs are spaced 0.012 in. apart by minor discs. Therefore particles larger than 0.012 in. can't enter. Particles down to 40 microns are stopped between inner edge of major disc and outer edge of minor disc.

PRECISION-GROUND MINOR DISC has radius just 40 microns short of major disc inner edge. Short effective length of micronic restriction gives the filter its high flow rate. Cleaner blade bears against outer edge of minor disc to comb out dirt.

CUTAWAY OF NEW SUPER AUTO-KLEAN. Dirty oil enters inlet (1) at left, fills housing (2) and flows through metal-edge filter (3) of stacked major and minor discs. Trapped dirt is combed out by cleaner blades (4) when discs are rotated and is removed through drain (5). Clean oil rises through center of filter element, leaves at right.

self-cleaning filter!

THE *Super* AUTO-KLEAN

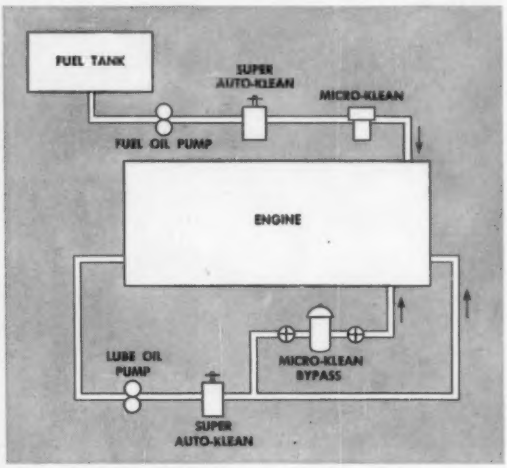
FOR FULL-FLOW LUBE AND FUEL

. . . and you can clean this filter by simply turning the handle!

Cuno's new Super AUTO-KLEAN filter now makes possible economical, compact full-flow micronic filtration for small high-speed diesels, and requires no more space than present bypass filters. Super AUTO-KLEAN makes full-flow filtration on large low-speed diesels more economical than ever before. Here's what it offers:

1. Full-flow micronic filtering with a self-cleaning filter. Filter can be cleaned continuously with motor drive or intermittently by manually turning handle.
2. Eliminates cartridge changes.
3. No pressure drop build-up (saves pumping horsepower). An 8-in. long, 2¼-in. diameter cartridge handles 25 gpm of lube oil of 200 SSU viscosity with only 3 psi pressure drop—up to 75% more with slightly higher pressure drop.
4. Positive engine protection against particles larger than 40 microns (actually 0.0015 in.). Filter can't rupture or channel.
5. No need to use large, expensive, high-maintenance cartridge filters. Oil can be kept in top shape with small, inexpensive bypass CUNO MICRO-KLEAN filter to remove particles smaller than 40 microns. Bypass cartridge lasts longer because it's not clogged with particles larger than 40 microns.
6. No duplex units needed. Super AUTO-KLEAN handles full flow all the time with no interruptions for cleaning.
7. Can't absorb or adsorb additives from the oil because it's all metal.
8. Uses standard AUTO-KLEAN housing on existing AUTO-KLEAN installations. You can easily replace most 2¾-in. diameter cartridges with Super AUTO-KLEAN for finer filtration.
9. Can be adapted to any existing engine. Simply install Super AUTO-KLEAN in the full-flow lube oil line following the discharge of the engine pump.
10. Gives lower initial costs, lower installation costs, requires less space than cartridge-type full-flow units. You get high capacity in a small package.

Send coupon for complete information on the new Super AUTO-KLEAN filter for your new or existing diesels. Cuno Engineering Corporation, Dept. 101-S, South Vine Street, Meriden, Conn.



SIMPLIFIED SET-UP for ideal lube oil filtration. Full flow goes through Super AUTO-KLEAN and is cleaned of particles 40 microns and larger on every pass. A CUNO MICRO-KLEAN replaceable-cartridge filter may be used where conditions warrant further clarification. Various element densities available to remove particles down to one micron. Housings available for either partial flow (as shown above) or full-flow hook-ups.

5.1

MAIL COUPON FOR COMPLETE INFORMATION

CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids from More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge)
FLO-KLEAN (wire-wound) • PORO-KLEAN (porous metal)

CUNO ENGINEERING CORPORATION

Department 101-S1
South Vine Street, Meriden, Conn.

Please send me full data on the NEW Cuno Super AUTO-KLEAN filter.

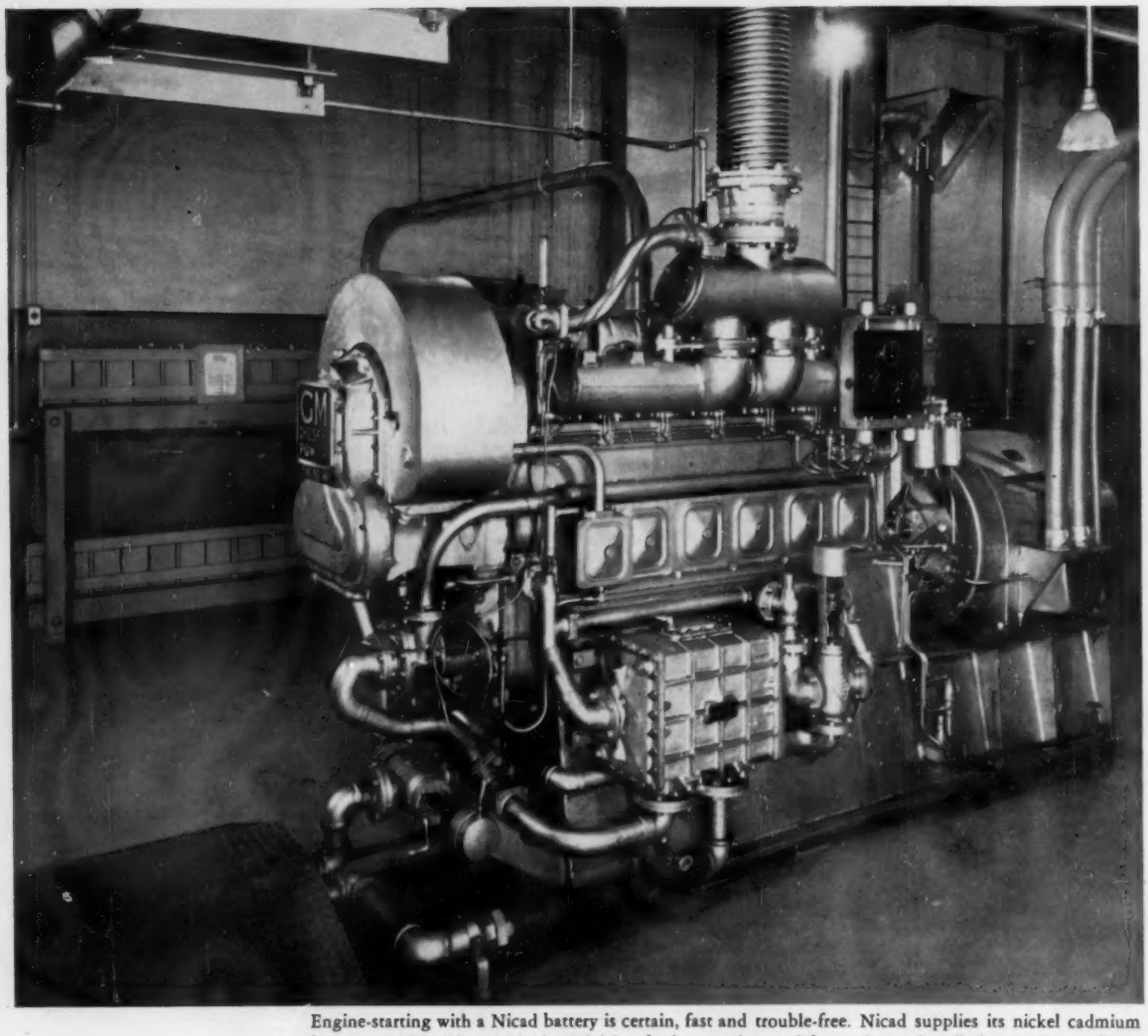
Name_____

Firm_____

Position_____

Address_____

City_____ Zone_____ State_____



Engine-starting with a Nicad battery is certain, fast and trouble-free. Nicad supplies its nickel cadmium battery to GM's Electro-Motive Division for locomotives and for stationary installations as shown above.

Modern way to start a Diesel

... it's a job that calls for Nicad

If you were to write the specifications for a battery to start Diesels, you'd find yourself listing the characteristics of a Nicad battery. What you see in this picture makes a perfect team.

Nicad batteries have that extra dependability that caused nickel cadmium batteries to become the standard in the vital services in many parts of Europe.

The battery was first made in this country by Nicad and is meeting *exactly* the special demands of Diesel engine starting. Its inherent characteristics are proving custom-grooved to the service.

Nicad battery construction is steel throughout, its alkaline electrolyte is a preservative of steel. The battery is equally rugged chemically and electrically. Its water consumption is negligible. The Nicad battery uses standard charging equipment.

Thus it can be readily seen how the Nicad battery added up to both the easy and correct answer at extremely low overall cost.

Data upon request. Write Nickel Cadmium Battery Corporation, Box 511, Easthampton, Mass.

NICAD

The Battery with the Steel Constitution

SEE THE GREAT GENERAL MOTORS POWERAMA

SIMPLIFIED DIESEL FUEL INJECTION AT ITS VERY BEST

The new, lighter, smaller, more compact Roosa Master D Pump offers both the diesel engine manufacturer and user outstanding diesel fuel injection performance, exceptional dependability and low maintenance cost through simplified design and construction.

Designed for use with almost all major types of high speed diesel engines, the Roosa Master Model D is a single cylinder, opposed plunger, inlet metering, distributor type pump.

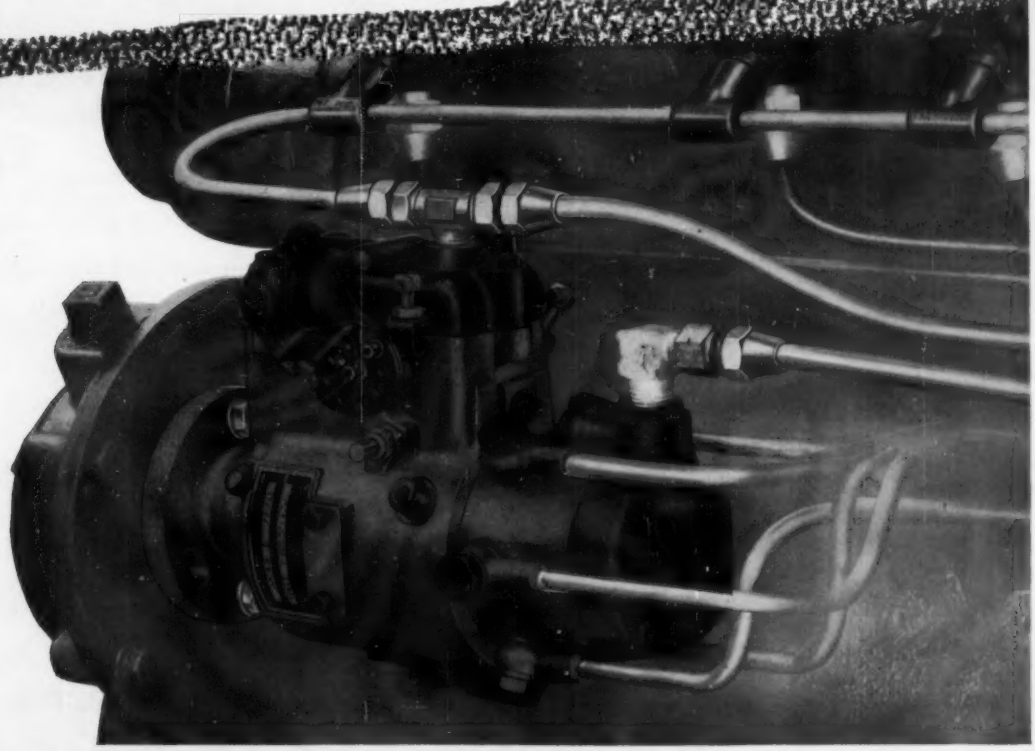
A study and comparison of Roosa Master D Pump features, as described and illustrated in latest "tell-all" folder, now available, will quickly reveal why the Model D **Makes Good Diesels Better!**

Write today for your copy—no obligation

HMS ROOSA MASTER

THE HARTFORD MACHINE SCREW COMPANY • HARTFORD 2, CONNECTICUT

Roosa Master Fuel Injection Division



Announcement!

General Motors
Detroit Diesel Engine Division
adopts Perry Cooling System
Filter and Conditioners
as standard equipment on
their marine engines...and
as approved optional equipment
on their industrial power engines.

Perry Filters extend engine life by keeping the cooling system constantly clean, free of rust, water scale and insulating deposits!

Ask your G. M. Diesel Engine Distributor about Perry Filters

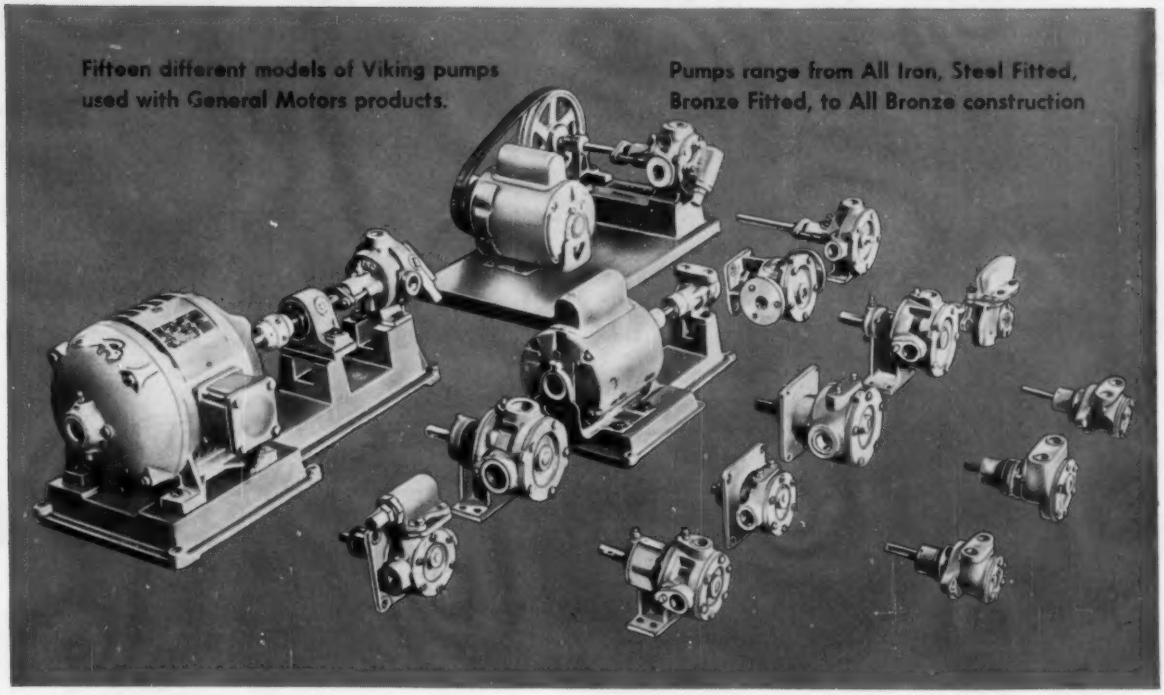
Perry COOLING SYSTEM filter and CONDITIONER

PERRY FILTER DIVISION, DEPT. G

R. M. Hollingshead Corporation 840 Cooper Street, Camden 2, N. J.

VIKING PUMPS ARE STANDARD ON GENERAL MOTORS

ALLISON • CLEVELAND DIESEL • ELECTRO-MOTIVE EQUIPMENT


Fifteen different models of Viking pumps used with General Motors products.
Pumps range from All Iron, Steel Fitted, Bronze Fitted, to All Bronze construction

TO maintain General Motors quality, equipment used as integral parts must meet rigid standards. Viking Pumps are built to meet those rigid standards. Viking quality is available for your pumping problems, too. Either custom built to fit your needs or standard construction to answer many purposes.

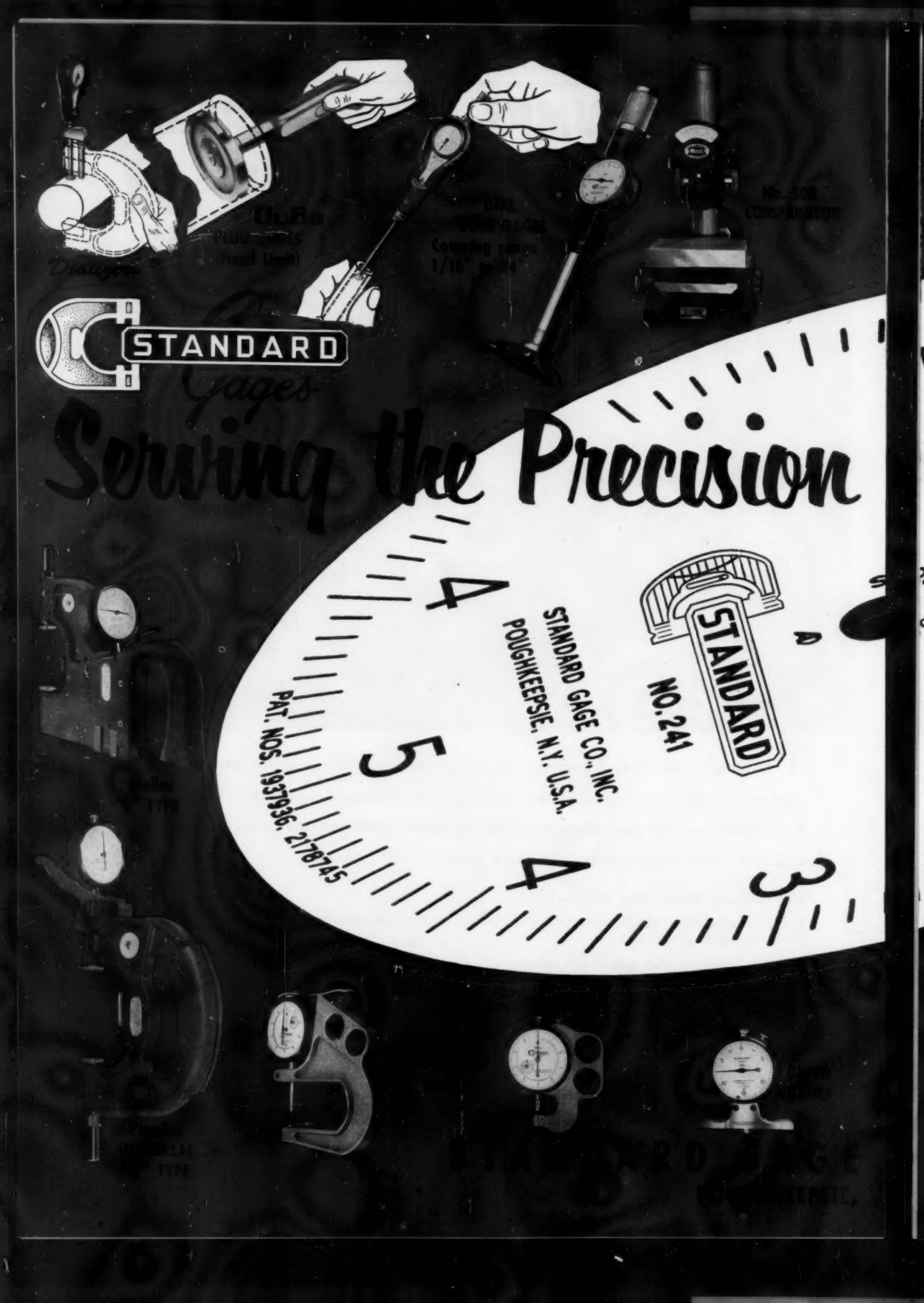
Like General Motors, you too can have:

1. Fast self-priming; positive suction and discharge; smooth, even flow.
2. Sizes from ½ to 1050 gallons per minute.
3. General Purpose types up to 100 psi.
4. Heavy duty types up to 200 psi.
5. Hydraulic oil pumps up to 500 psi.
6. 750 cataloged models, plus thousands of special designs to choose from.
7. Pumps that will efficiently handle liquids from LP-gas, fuel oil, diesel fuel, lubricating oil to asphalt and grease, as well as hundreds of others.

To start, send today for free bulletin 55SD . . .

See Viking Pumps on General Motors equipment at the Powerama, Chicago, August 31 to September 25.

VIKING PUMP COMPANY
Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps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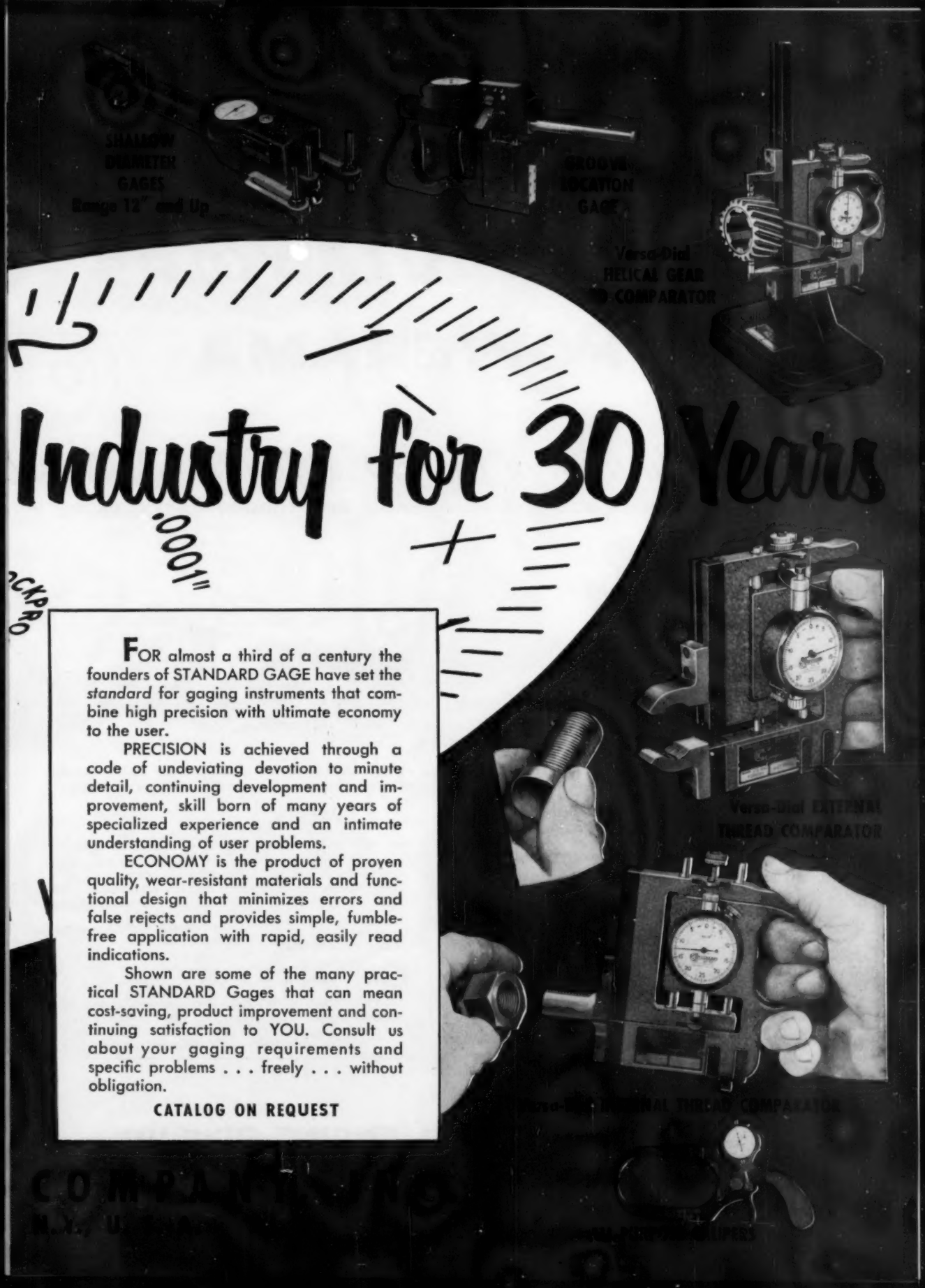


FOR almost a third of a century the founders of STANDARD GAGE have set the *standard* for gaging instruments that combine high precision with ultimate economy to the user.

PRECISION is achieved through a code of undeviating devotion to minute detail, continuing development and improvement, skill born of many years of specialized experience and an intimate understanding of user problems.

ECONOMY is the product of proven quality, wear-resistant materials and functional design that minimizes errors and false rejects and provides simple, fumble-free application with rapid, easily read indications.

Shown are some of the many practical STANDARD Gages that can mean cost-saving, product improvement and continuing satisfaction to YOU. Consult us about your gaging requirements and specific problems . . . freely . . . without obligation.

CATALOG ON REQUEST

A Show you'll never forget!

GENERAL MOTORS POWERAMA

Gala Celebration of the 100 Millionth GM Diesel

LAKE SHORE SOUTH, CHICAGO—AUG. 31ST THROUGH SEPT. 25TH

GM Powerama presents—"roads a-building" exhibit of GM Diesel-powered equipment for both concrete and asphalt highway construction—dump trucks, concrete paver, rock crusher, graders, rollers and scrapers.

MAKE your plans now! The General Motors Powerama will be a national event too important, too spectacular to miss.

On 20 acres of grounds, a World's Fair of Power will unfold wonders galore. Fascinating exhibits—thrilling demonstrations—a colorful stage show—everything to make your visit interesting, educational and well worth the trip.

Come and bring the family. *Admission free!*

Plus many other interesting exhibits you won't want to miss—

ALLISON TURBO-JET and TURBO-PROP engines that power America's finest, fastest fighters and transports.

CLEVELAND DIESEL engines powering a submarine you can go aboard and inspect.

ELECTRO-MOTIVE's advanced lightweight 100-mile-an-hour train with its amazing new air-suspension springing.

EUCLID's full line of 10- to 50-ton Diesel trucks and 7- to 18-yd. scrapers.

FABRICAST's exhibit of modern casting methods.

GMC Diesel trucks and coaches, SceniCruiser and spectacular new "L'Universelle."

And a Complete Exhibition of GM's 7 Dazzling Dream Cars:

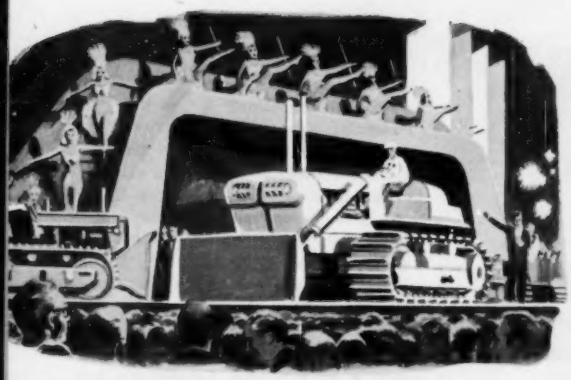
CHEVROLET BISCAYNE • PONTIAC STRATO STAR • OLDSMOBILE "88" DELTA • BUICK WILDCAT III • CADILLAC ELDORADO BROUGHAM LA SALLE II SEDAN • LA SALLE II SPORTS CAR

GM GENERAL MOTORS DIESEL POWER

DETROIT DIESEL ENGINE DIVISION

GENERAL MOTORS • DETROIT 28, MICHIGAN

In Canada: General Motors Diesel, Ltd., London, Ontario

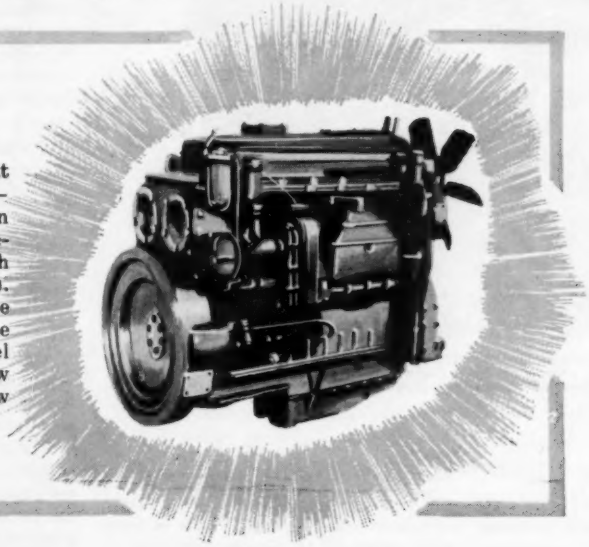


GM Powerama presents—"More Power To You"—a mammoth variety show in which Diesel-powered vehicles perform fantastic maneuvers—with Big Top circus acts and a huge cast of dazzling dancing starlets.

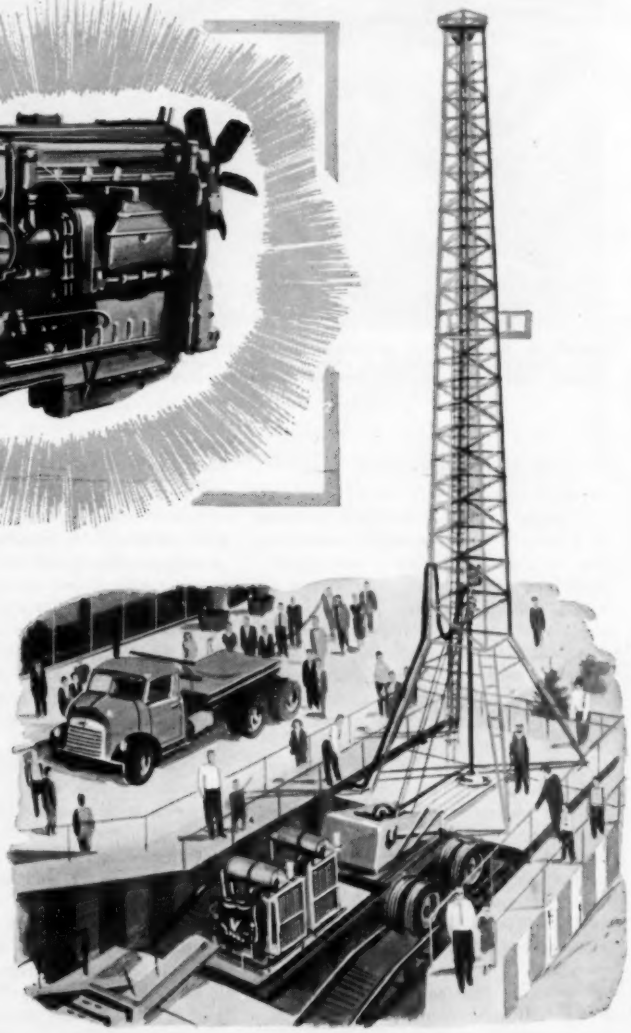
GM Powerama presents—a wide variety of interesting, *operating* exhibits showing the use of Diesel power in many fields including a sawmill, a cotton gin, an irrigation system, a farm tractor and a feed mill.

Horsepower

GM Powerama presents—at the head of the parade—Detroit Diesel's golden "6-71" Diesel engine (representing 100 Millionth General Motors Diesel H.P.). Also, Dr. Diesel's first engine and exhibits ranging from the 1933 World's Fair Diesel engine to the compact new "51" engine that opens new fields for Diesel usefulness.



GM Powerama presents—a marine display including GM Diesel-powered shrimp boat and 36-foot and 22-foot pleasure craft for the interest of those who want Diesel safety, speed and economy in their boats.



GM Powerama presents—a modern, portable oil-well drilling rig in action, powered by General Motors 2-cycle Diesel engines which have won a reputation for "more power in less space with less weight."

Harlow H. Curtice (left), president of General Motors, and C. R. Osborn, vice president in charge of GM's Engine Group inspect scale model of GM's million square-foot Powerama.

Detroit Diesel Division

threatens to steal the show with its real-life display of diesels actively performing in practically any commercial undertaking you can name. You'll see • raw cotton ginned and baled before your eyes • a rock crusher crunching out road stone • a saw mill cutting up timber • a trailer-mounted oil drilling rig in operation, crew and all • a tractor plowing up a farm field and • an irrigation pump in action. Every type of road-building equipment will be shown stopped in a realistic pose in • a highway under construction. Docked at the pier for your inspection will be • one of the smallest diesel-powered cruisers, a 22-footer • a 37-ft pleasure yacht • a 65-ft shrimp boat complete with shrimp-harvesting equipment • a 31-ft crew boat used in offshore drilling and • a 90-ft fire boat. Arrayed on exhibit will be every kind of marine, industrial, railroad, and truck and bus engine produced by this division, in full size and with motorized workings of their parts. And to show you how its customers are trained to keep their GM diesels fit, there'll be a field training exhibit building and a mobile training unit.

Electro-Motive Division

will shoot the works railroad-wise. Taking up a quarter mile of track will be • seven standard diesel locomotives, including an export model • and you'll be urged to climb aboard and operate a couple. • Two before-and-after units will show you what happens at the rebuild plant. You'll see • the new lightweight train • a railroad test car and • the latest in refrigerator cars. There'll also be • a 250,000-scale model collection of locomotives on 100 American railroads • a diorama of what designers think our railroads will look like 50 years from now • a model maintenance shop • a million mile piston • a 30-ft tall tube showing how fuel oil explodes in a locomotive cylinder, and operating and cutaway models of control relays, blowers, and trucks. Other exhibits will feature • a crew-manned oil drilling rig with a 147-ft derrick, taking you through all the phases of deep-well drilling • a diesel-operated pump jetting a 50-ft column of water out to Lake Michigan and • the first public showing of the Electro-Mobile power units which you'll start and stop by remote control walkie-talkie and by telephone dial.

GMC Truck & Coach

will have eight of its truck models and seven bus units taking part in the Powerama. The trucks will serve as workhorses at other divisions' displays. You'll see them at the feature exhibits • pulling a portable drill rig • loaded with 32-ft logs for the saw mill • supporting the feed mill • hauling raw and baled cotton for the gin mill, and • a 50,000-pounder will power an oilwell servicing unit mounted atop it. Three of the giants will take their places at the roadbuilding show. At the bus display, you'll • walk through Greyhound's new Scenicruiser and • have a closeup view of the experimental gas turbine-powered Turbocruiser. Standard intercity and transit coaches will be on display. An animated tractor-trailer will show you the workings of air suspension. There'll be a vee-drive exhibit and cutaways of diesel truck engines and twin Hydra-Matic transmissions.

Cleveland Diesel Division

invites you to view its display of engines and their applications in both industrial and marine service. Step into the Perimeter Building and you'll see • two models of the largest GM engines which produce 3300 hp on natural gas • an 8-cyl generator set used by telephone exchanges for emergency standby service • the first-time-ever exhibit of its new turbocharged 16-cyl diesel engine • a working model of an LST and • the main propulsion unit and • impulse generator set for the Navy's newest mine sweepers. You're also invited to board • the Laurence C. Turner, largest tug on the Great Lakes, which receives its power from a 1740-hp diesel and • the USS Tautog, the Navy's World War II "Terrible T" submarine which is propelled by four 16-cyl diesel engines.

Fabricast Division

will focus your attention on its production operations. You'll see • an aluminum foundry making crankcase covers for diesel locomotives in a working demonstration of its permanent mold process. To show you how it molds heavy-alloy turbine blades by the lost wax process • one million key chains will be cast on the site and handed out as souvenirs. Too big to include as live exhibits, other foundry operations will be shown by color films. You'll see the 60 different types of castings produced for other GM divisions on display, including • a mechanized locomotive hatch ventilating fan • a motorized Roots blower, and diesel cylinder blocks, housing, and torque converters. You'll see • ultraviolet light bringing out invisible flaws and • a transcriber machine making exacting contour checks.

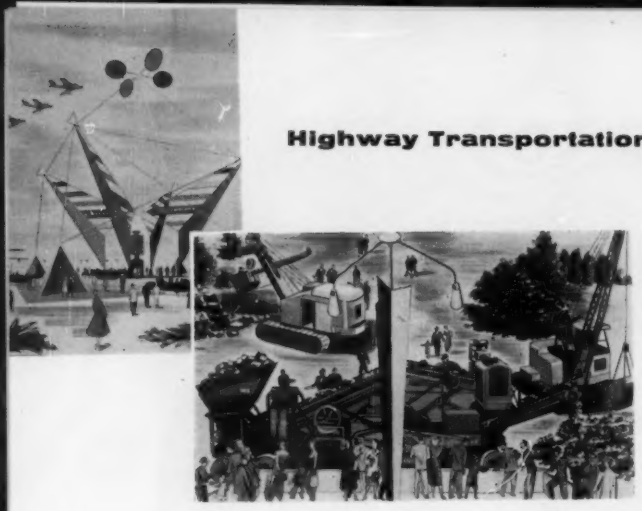
Diesel Equipment Division
whose sub-assemblies and vital precision parts go into almost all equipment shown at the Powerama, will devote all its diesel exhibits to the unit fuel injector. Center of attraction will be • an operator drilling microscopic spray holes in the tips, in sizes ranging from 5 to 17 thousandths of an inch. Exploded views will demonstrate aill the individual parts of an injector. There will be field application photos and • a large energized cutaway will be shooting fuel into a diesel combustion chamber.

Allison Division
will concentrate its main diesel exhibits on its Torqmatic drives. To demonstrate the contrast in ease of operation and maneuverability between mechanical and Torqmatic drive, you'll actually be able to operate • a 50-ton truck loaded with ore and • a heavy-duty crane swinging a 4-ton ball under both drives. There'll be • a Budd rail car and • many earthmoving machines to show you Torqmatic applications in these varied fields. • A diesel engine blower and • a diesel hydraulic starter will also be on display. And other exhibits will feature fullscale cutaways, scale model equipment, and color films to round out just this phase of Allison's numerous activities.

Euclid Division
will exhibit its entire line of big-muscled movers. You'll see • 31 models of every type—rear-dumps, bottom-dumps, scrapers, tractors, loader—at work or on display in the earthmoving show. And you'll be privileged to have the first public view of • the new C-6 crawler tractor and • the new S-12 rubber-tired scraper. Eucs will step into the limelight as star comics at the stage shows where • they'll engage in a power play with live elephants and • team up with dancing girls in a Mambo routine. And to top all stage props • the world's largest dump truck, a 50-tonner, will be filled with water and used as a swimming pool in an acrobatic comedy sequence.

Research Laboratories Division
will indulge your scientific curiosity with its array of working instruments. You'll be invited to operate • the Sonigage • infra-red heat detector and • Surfigage. History minded? You'll see • Dr. Diesel's first engine in replica and a picture display of his career. You'll see • the famous Winton 8-cyl engine and • a scale model of Big Bertha, first GM 2-cycle engine. And while mechanized pistons, fuel injectors, and blowers work away, you'll view developmental stages in piston cooling, hydraulic valve adjusters, and heavy-duty lubricants.

POWERAMA—a dramatic symbol of an important industry. While conceived to dramatize the accomplishments of one corporation and its divisions in providing "Muscles for America" serving all basic industries, it cannot fail to emphasize the importance of the diesel industry as a whole. Our dynamic economy is competitive and what one organization does is in competition with similar achievements of others. Promote and build a bigger industry, and the share of each segment of that industry is bigger and all prosper. Estimates indicate that some 3 million people will be impressed with this symbol of diesel power at work. The power, capacity, and versatility of each character in this drama will be demonstrated. But no matter how vast the stage, there are limitations. What of ruggedness in day-to-day operation? And what of the all-important economy of operation? These must be told separately: a form of libretto is needed. That is the purpose here. First comes the story of the divisions that build the muscles—the prime movers. Then there are those that build vital parts—the components. Next, those that build the machines to apply the muscles. And finally, something of a "bank" of engineering resources that helps solve today's problems and looks to the future . . .



Detroit Diesel Engine Division

Diesel engines for all of industry

HIGH efficiency of the diesel engine has always been recognized, but before diesel power could reach its rightful place in the world's economy very substantial reductions in diesel size and weight has to be effected.

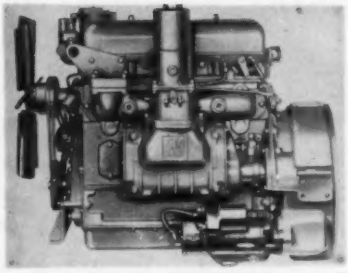
Detroit Diesel Engine Division started production of its Series 71 line of engines in 1937, providing a comparatively light and compact source of diesel power which was to start General Motors on its way to the outstanding diesel production record of 100 million horsepower achieved this year.

These engines were first produced in 2-, 3-, 4-, and 6-cyl engines. Later, by the addition of multiple units consisting of two or four engines driving a single shaft and operated by single controls, the horsepower range was increased considerably. To meet the need for more powerful single engines, the 6-110 diesel was introduced and later the division added the snappy new "4-51" smallboat diesel to its line.

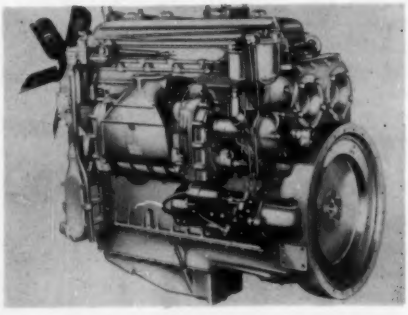
With a range of from 30 to 893 horsepower now available, Detroit Diesel was in a position to supply a diesel power plant for practically every industrial and marine power need. Of General Motors' overall diesel production, this division has today turned out engines to the equivalent of over 64 million horsepower with two other diesel divisions rounding out the 100 million horsepower total.

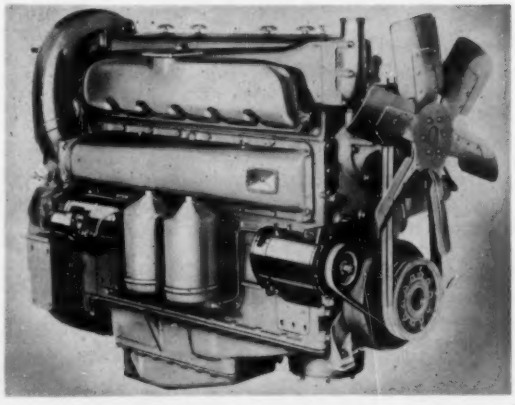
Applications now range from pleasure boats as small as 22 feet in length to the giant oilwell drilling rigs in common use today. Other important installations are in trucks, buses, earthmoving and roadbuilding machinery, portable and stationary saw mills, cotton gins, farm tractors, tugs, fishing boats, and many others. According to Detroit Diesel spokesmen, these engines are being used today in over 750 industrial applications alone.

Detroit Diesel's production record, achieved over a period of 18 years, is impressive. It has gone far in promoting the important part diesel power has come to play in today's world economy.

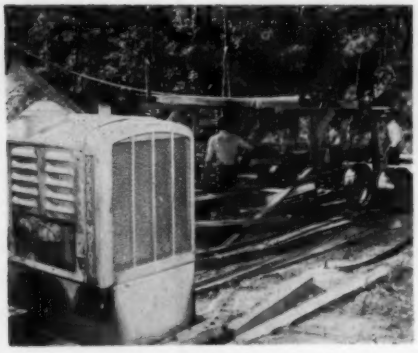


Detroit Diesel's family of engines with the "4-51" at right, series "71" engine below, followed by the "6-110" engine.





n Washington, two men and a GM 3-71 engine verage 9000 bd ft per day. Portable sawmill akes only three days to set up on new site.



Similarly-powered mill in North Carolina saws and edges 10,000 bd ft per day. Portability permits operators to move right to the trees.

Positioning logs for roll-ups. Replacing steam power, diesel-powered donkeys roll carloads at a time, producing rafts faster and cheaper.

Lumbering Industry — and Early Application

ONE of the first major industries to try out and accept the GM diesel engine as a prime mover was the lumbering industry. Today, in practically every wooded section of the country, these engines are at work not only in portable and stationary sawmills but also in yarders, loaders, tractors, and the trucks that move logs to and from the mills.

This widespread use of diesels in this industry is due largely to the inherent economy, dependability, and freedom from fire hazards that these units afford. The economy and flexibility of modern diesels provide a potent weapon to combat generally rising costs.

Lumbering is tougher than it used to be. You don't find the close-by virgin forests of a century ago. You range further afield, you work less promising areas, and you must get the logs or lumber back to the market. Big operation, little operation—the problems are the same; it's just a matter of scale.

Consider three types of problems and see how Detroit Diesel's engines contributed to their solution.

Rayonier Incorporated of Seattle, Washington, has a logging operation in Clallam Bay, Sekiu, Wash. At this location the company engages in collecting and rolling timber into log rafts which are towed to other points where wood cellulose is produced. Logs are brought to Sekiu by rail and dumped into the bay by the carload.

Two donkeys are mounted on barges located a quarter of a mile from the shore for power to aid in forming the rafts. Originally these were steam-powered. Evans Engine and Equipment Company of Seattle performed the conversion to diesel power. Series 6-71 units with integral torque converters were installed.

The benefits are primarily economic but can be broken down into three contributory categories: fuel savings; operational advantages; and borrowing a word from the military, logistics.

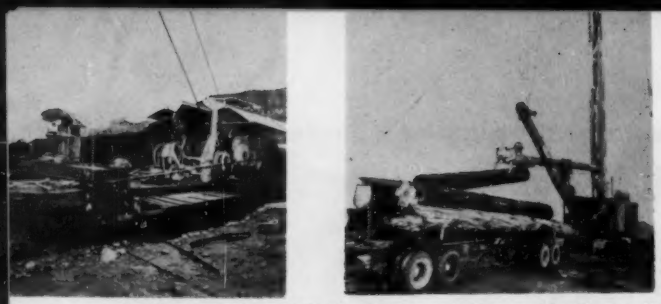
In the steam operation, 270-gal of crude oil per day were needed to fire the boilers. The two diesels are currently using a total of only 70 gal of diesel fuel per day. The disparity of gallonage far outweighs any spread in costs.

Operationally, more work is done per day. Power is now available at the press of a button and no time is lost in maintaining or getting up steam. Speed with which logs are rafted is stepped up because logs are now rolled in bundles equal to carload lots. They used to be handled singly. Obviously, there is more power available for less cost.

Another operational aspect concerns wear and tear on equipment. The torque-converter drive has given evidence of being easier on the equipment including the engines. This is due to an ability to apply power smoothly and ease and absorb any shock loads.

Logistics concern supply problems and we'll stretch it to cover manpower. Moving enough oil for a 270-gpd consumption, plus the makeup feed water, is not a light chore. Knock off 200 gal of oil, plus the water, and your supply problem is greatly reduced. Fewer trips mean more manpower and equipment availability for other jobs. Also, it was found that three less men were needed to operate the two diesel units, freeing them for other more productive work.

Cut lumber is lighter and more compact than the logs from which it was cut. So in some cases it may be desirable to move the sawmill to the trees. If the sawmill, with its power source, is portable and flexible enough to permit easy transportation and simple quick setup, real savings can be realized.



Washington yarder and Northwest shovel, both powered with Detroit diesels, make logging of burned-over areas feasable and profitable.

You'd think that with all the wood waste, sawdust, etc., that a wood-fired steam plant would be the most economic form of power. Yet, diesel-powered rigs, some even built into special trucks, are flourishing. The flexibility of operation afforded lets the small operation move right into areas too marginal for largescale exploitation. They can glean the area and ship out sawn and edged lumber.

Two such operations are illustrated. In a forest near Raleigh, N. C., a GM 3-71 power unit provides ample power to produce 10,000 bd ft of lumber per day. Power unit, sawmill, and edger are arranged for easy movement when the owner finds it economic to pick up and move to a new location.

John Strandjord of East Standwood, Washington, also has a portable GM-powered sawmill. Using a 3-71 diesel for power, two men average 9000 bd ft of lumber a day. When the sawmill is ready to move, it takes three days to get set up in the new location.

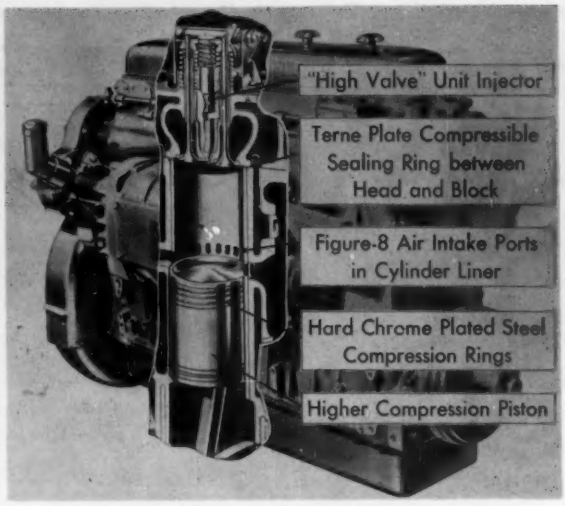
Today's demands for wood cellulose has opened up a new market for otherwise waste wood products. Typical of these is burned-over timber, but extreme economies must be practiced so as to make its recovery profitable to the logger.

Diesel power for loaders, yarders, and trucks is one way that logging contractors have made this type of operation possible. Take the case of the Spoelstra Brothers of Forks, Washington, who are currently operating in a large burned-over area in that vicinity.

Ted Spoelstra, in charge of the company's equipment, said that the lower cost of diesel fuel and the reduced gallonage required compared to other fuels, partially offset the reduced footage harvested per day. Reduced gallonage also means reduced fuel-haulage costs, especially important when the operation is located in isolated mountain areas.

He also cited the comparatively long service life of diesel units, their ease of maintenance, and freedom from downtime as other economy factors. By shaving operational costs, such enterprises become economically feasible resulting in greater utilization of natural resources.

In one location in the Forks Burn area, Spoelstra Brothers were yarding a distance of 1100 ft and loading around 40,000 bd ft of burned-over timber per day. Equipment used was a Washington yarder and a Northwest shovel-loader, both powered by 2-cycle Detroit Diesel engines.


"High Valve" Unit Injector
Terne Plate Compressible Sealing Ring between Head and Block
Figure-8 Air Intake Ports in Cylinder Liner
Hard Chrome Plated Steel Compression Rings
Higher Compression Piston

Series "71" power assembly modifications brought about by a continuing program of development and refinement.

DETROIT Diesel's Series 71 engine is the oldest and most widely used of their engines. It is "old" only in the sense that it was the first of their designs introduced. A continuing program of development and refinement, along with a policy of providing modifications that can be incorporated into older engines means that the operational level of all engines is kept at high standards. Older engines can be updated in the field when repair or overhaul is necessary.

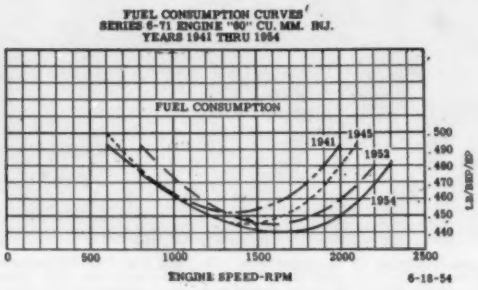
Research and development produced the Series 110 and 51 engines since World War II. The same refinement program has been applied to them.

Modification to the Series 71 engines were announced as they were job-proven in the field. When you add them all up, you find that the entire power assembly has been modified to increase service life, step up performance, and improve fuel consumption. Externally, there appears to be little change. Detailed examination and a performance check prove that something has been added.

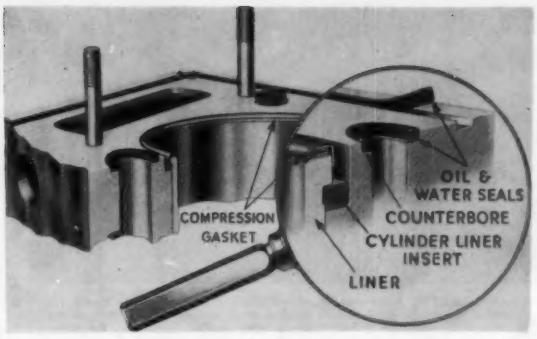
Cylinder Sealing has been improved by a metal-to-metal fit of head and block. The block face was grooved and counterbored to accommodate individual oil and water seals of synthetic rubber. Combustion chamber sealing at the higher pressures was assured by a redesign of liner mounting and gasketing.

The liner flange counterbore was deepened to take a ring-shaped insert on which the liner flange rests. Proper liner protrusion can be controlled. A compressible ring-type metal gasket fits between the liner and the head.

In all cases, maximum load is concentrated around each compression sealing surface. While on the subject of loads, the whole block was "beefed up" where it counted and fastener strength improved.



Steady improvements resulting in lower fuel consumption are a direct payoff to Detroit diesel users.



Metal-to-metal fit of head and block improves cylinder sealing. Individual gaskets are used around every block opening.

Product Improvement — A Continuing Program

Freer Breathing was the objective of several changes. Exhaust valve seat angle was changed from 45 deg to 30 deg to provide more flow area for the same lift, less flow turbulence, and longer valve life.

Liner port design was altered to provide 20 "Figure Eight" ports drilled at a 25-deg angle, replacing 15 circular ports at a 30-deg angle. Approximately 30% greater air intake area is obtained and swirl action of incoming air is improved.

Piston and Ring Changes were made for better utilization of the increased air flow and containment of the higher pressures. Size of the piston's crown cavity was altered, permitting more energy to be utilized from the fuel burned. Increased radius at the outer edge of the dome cavity improved heat flow toward the cooler portion of the piston.

"Lite-Tite" compression rings were adopted. These feature hard chrome plate on steel rings. The steel body is considered tougher and more flexible (for conformability) than rings used earlier. The chromed faces show great resistance to abrasion and corrosion, all adding up to longer life.

Unit Fuel Injectors were changed to the new "high-valve" type, developed by Detroit Diesel in conjunction with the Diesel Equipment Division. The "HV" on the identification tag derives from the higher location of the injector valve and relocation of the check valve to a point below the injector valve and spring. Movement of the spring out of the high-seat zone has greatly improved service life.

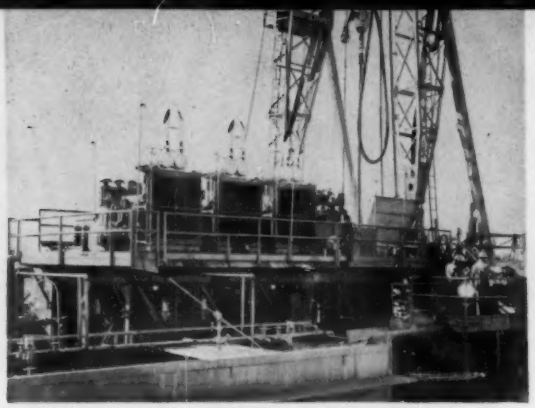
Several injector parts were redesigned at the same time for simplification and to accommodate the altered spacing. For instance, barrel and plunger assemblies were shortened. Bearing out the policy of permitting updating of engines at the time that the new parts were put into production, two kits were introduced. One permitted the shortened parts to be used with the earlier valve and spray tip; the second was designed for conversion to the high-valve design.

Changes for Vehicular Engines included a new "170-deg" camshaft designed to alter valve timing for this application. Scavenging at the higher rotative speeds was improved and fuel economy increased by about 6%.

The governor was modified by addition of a fuel "modulator". Its function is to feed automatically the right amount of fuel and air for maximum efficiency regardless of throttle position. It exerts its maximum effect at engine speeds below 1500 rpm, the point where a driver could otherwise lug the engine and waste fuel.

Of course there were other changes and modifications incidental to these described. Improvements in component design, metallurgy, finish, and lubrication are a continuing process. The accompanying chart shows the performance gains through the years in one very important item—fuel consumption. Horsepower ratings and service life have similarly improved.

While all this was going on, the "6-110" engine has been undergoing somewhat similar changes. It has the same type of improved liner porting; pistons have been altered; and the high-valve injector idea adopted. (Series 51 engines have it too.) These, with other component improvements, have allowed higher ratings. Originally rated 300 bhp at 2000 rpm maximum, and 230 hp at 1800 rpm continuous, an increase of 25 hp and 17 hp, respectively, has been gained. Permissible speeds are up 200 rpm and performance generally improved.



Oilwell No. 96 drawworks on Richfield Corporation's rig is powered by three GM 6-110 Twins with torque converter drive. At 9000 ft, pipe in 90-ft stands was pulled in 1 hr, 20 min.

Built and launched at St. Augustine, Fla., the GM "6-110"-powered shrimp boat came up the Atlantic Coast, through the Erie Canal and the Great Lakes to show northerners how shrimp is harvested.

Detroit Diesels in the Oil Fields

APPLICATION of Detroit Diesel Division's engines in oilwell drilling operations had to await the end of World War II. The first of these engines went to work on west Texas rigs in 1945. Since then, their use has expanded to practically every oil-producing section in this country and to Canada, Mexico, South America, and many other parts of the world. They are operating on land and on big drilling barges for offshore operation.

Light weight and compactness have been important factors in their use. Even the powerful 4-engine "Quads" fit this bill and have added to the portability of the rigs. Their compactness has permitted many rigs to be moved intact with engines and without violating vehicle width restrictions on the highways.

In single or in multi-engine units, power can be matched to the job whether it be operating the draw works, powering mud pumps, or supplying electrical power for general service. Power can be supplied mechanically or through fluid couplings or torque converters to fit the requirements and do the most efficient job.

An interesting application of these engines is for the new hydro-fracturing technique developed in the oil fields. The principle is to pump the well full of oil and sand of controlled grain size under sufficient pressure to fracture the surrounding strata.

Pressure is built up until the oil-sand mixture opens the fissures to the oil pocket. Once fissures start to open up, a high flow rate is maintained to extend the fractures. This cycle of operation is admirably suited to the capabilities of a diesel driving a high-pressure pump through a torque converter and "quick-shift" range gearing.

In this process, new wells have been brought in, production restored in wells that have been tapering off, and wells that have stopped producing have been brought back to life.

Marine Applications Demonstrate Versatility

A shrimp boat, MISS POWERAMA, on Lake Michigan will be a novelty, but Detroit Diesel engines in shrimp boats are nothing new. Diesel Engine Sales, Inc., St. Augustine, Fla., builder of MISS POWERAMA, has installed a good many in their construction of 526 shrimp trawlers. At the close of World War II, foresighted shrimp fishermen could see increasing demands for all seafoods, thanks to the boom in refrigerated shipping.

You had to go further out for the biggest and best shrimp and to make things pay, you had to get a bigger catch. Boats got bigger, reliability was essential, and need for maximum economy became very important. Back in 1947, Captain Carl Muchowich, pioneer shrimp producer of Freeport, Texas, saw this and converted his 12 trawlers to diesel power.

GM 6-71 engines were installed by Stewart and Stevenson Services of Houston. With all 12 trawlers converted, Captain Muchowich commented that his expenses were materially reduced by the lower fuel costs and that he was able to get out and back faster. More trips, more income. Freedom from breakdown was cited as a big item. He stated that a few breakdowns at the peak of the shrimp run could easily cost a boat owner enough to pay for a new diesel engine.

Then came another idea. The Gulf Frozen Shrimp Company of New Orleans, figured it a waste of time and money to haul home uncleaned shrimp. If they could be cleaned, packaged, and frozen out on the Gulf, a tastier, bigger and more valuable catch could be brought in. The ARCTURUS, built by Higgins, Inc., also of New Orleans, was the outcome.

The machinery arrangement is a good study in utility and flexibility. Propulsion power was provided by a Twin 6-71 unit, each engine having a front power take-

Four GM 6-71 diesel engines are installed in the "Clevelander", the City of Cleveland's fire boat. Two engines used for propulsion double as pump engines when boat gets to the fire.

"Jimmy D VI's" GM "4-51" provides speed with diesel reliability, safety and economy.

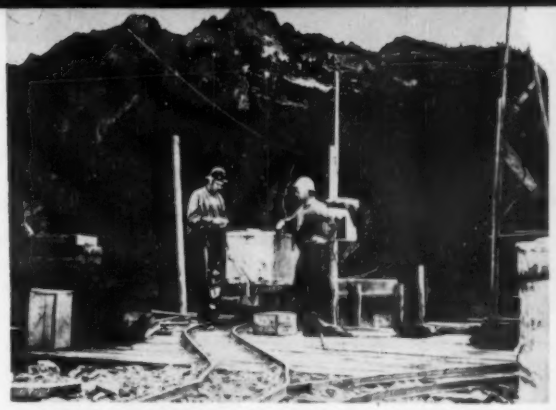
off. A GM 6-71 with attached 75-kw generator provided electric power for ship service and refrigeration. It too had a front power takeoff. This was connected to bilge and trimming pumps. Connection of the main engine takeoffs were: port engine—to an auxiliary 75-kw generator; starboard engine—chain-belted to the hoist machinery.

This arrangement provided maximum utility of installed horsepower and also maximum protection against results of an engine failure. The 108-ft vessel had a 10.8-knot speed (9 knots on one engine), and had a freezing and storage capacity for 75 ton of processed and packaged shrimp.

The dual use of engines through the mediums of cut-off clutches and power takeoffs is not unique. The same principle is used on a new GM diesel-powered fire boat for Cleveland, Ohio. A total of four "6-71" diesels provide both pumping and propulsion. Two are used for propulsion, but can be connected through front power takeoffs to the same type of Fairbanks-Morse centrifugal pumps as driven by the two pumping engines.

Cruising speed of the 58.4-ft craft is 12 mph (top is 14 mph). When pumping, each pump produces 1500 gpm at 140 psi to one of four monitors. It is also possible to pump into shore lines.

Probably the baby of all Detroit Diesel installations is the "4-51" loop-scavenged engine in the 22-ft JIMMY D IV. The 87-shp engine turns a 14-in by 11-in wheel, direct drive, for a speed of 24 knots. Against the background of other Detroit Diesel-powered craft, the little cruiser emphasizes the range and flexibility of their line of diesels.



Cable dock at Kromona mine shaft. Ore is lowered 2000 ft for processing; mining and food supplies lifted to miners.

GM 6-71 Twin power for processing plant. Joe F. Krom, right, located mine; Ray Johnson, left, helped work out power supply.

Power for all Types of Mining Operations

MINING is a basic industry that must expand with an expanding economy. Raw materials are the life blood of industry. Diesel power has revolutionized concepts both as to production and costs in both surface and sub-surface mining. Let's take a look at both extremes.

Sixty miles northeast of Seattle, Washington, is the village of Sultan. And in the Cascade Mountains, 20 rugged miles from Sultan, is the mining property of the Kromona Mines Corporation. Ore taken from the mine is rich in tungsten, gold, silver, and copper. Joe F. Krom, prospector and head of the corporation, walked and climbed and pack-horsed the area to locate the site.

To get into production, about a million dollars worth of equipment had to be lifted the final 2000 ft to the mine shaft by cable. The cable line is still important, used to lower ore for processing and lifting mining and food supplies to the miners. Miners are housed on the upper level for 5-day periods.

Ore processing takes place in the 8-story flotation plant where a 98% recovery of gold, silver, and copper and 80% tungsten recovery is being attained. Electrical power is needed at the plant and its inaccessability, to say nothing of weather conditions (buildings were de-

GM diesel-powered vehicles carry 20 ton loads to Eagle-Picher Co. mine adit. Even personnel carriers are dieselized.

A GM diesel-powered drilling unit operating miles away from the entrance of the Eagle-Picher zinc mine.

signed for a 15-ft snow load), rules out power lines.

Here is a case where compact, lightweight, and dependable power was essential. Evans Engine and Equipment Company of Seattle, worked out the power problems. A 200-kw GM diesel generator set supplies power for the plant. Drilling and mucking machines in the mine are operated by a 365-cfm compressor driven by a 4-71 engine.

Now let's look at the other extreme, where diesels themselves go underground.

Near Miami, Oklahoma, the Eagle-Picher Company mines zinc 300-ft below the ground level. Over 85 miles of underground roads have been tunneled. Where mules were once the motive power, diesels have now taken over.

In 1947, the first piece of diesel-powered equipment, an Allis-Chalmers HD-5 with a GM 2-71 engine was lowered piece by piece and then reassembled and put to work. Now mechanization is general with hauling vehicles, shovels, loaders, drills, and personnel cars—all diesel powered. Fifty units have GM 2-cycle engines.

Like the mules they displaced, these units seldom if ever see the light of day. Once lowered into the mine, they stay there. There are underground shops where equipment is assembled, serviced, repaired, and overhauled.

Mechanization and choice of diesel-powered equipment is paying off for Eagle-Picher. Modern shovels and loaders, and haulers moving up to 20-ton loads are enabling them to get high production at minimum costs.

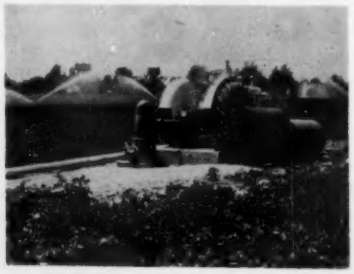
GM powered Lima Paymaster doubles as crane and dragline setting 72" tile. De-watering system pump is driven by GM "3-71".

Hammermill, primary crusher and two 3/4 yd. shovels powered respectfully by GM twin "6-71"'s, "4-71", and "6-71" units.

Power For Various Construction Jobs

Agricultural Power

Oliver Super 99 GM tractor with "3-71" pulls 5-bottom, 16" plow. Also doubles as pump power in summer.



ROADBUILDING and heavy construction projects are proper jobs for diesels. From cut and fill to final paving, and from site excavation to setting steel, today's jobs demand the high work capacity, the ruggedness, and the economy of diesel-powered equipment.

Contractors are finding that it pays to use diesels for all the tasks involved in such operations. Diesel power for earthmovers—dozers, scrapers, graders, dumps, etc.—is just about standard today. The trend is marked also in the machinery for all the other jobs involved in these projects.

There are so many critical jobs where a high level of production and continuity of operation are vital if the project is to be kept moving. Failure of a shovel in a borrow pit can immobilize the hauling equipment and the machines at the point of delivery. The failure of a dragline shaping a critical cut can hold up the whole job. This type of downtime with many pieces of machinery involved is really expensive.

Drainage is always a consideration. Ditches, trenches, and even wide cuts may have to be made. When sanitary lines and storm sewers are involved, other work may be awaiting completion of this part of the project. So speed is a factor.

Another phase of drainage concerns the ground water level. In many areas this may be high enough to interfere with the work in various excavations. De-watering becomes necessary and any failure in the continuity of the wellpoint pumping could seriously hamper completion of the project.

Rock crushing, the handling and screening of aggregates, and operation of bituminous or concrete batching plants are typical applications for diesel. This is tough work for really heavy-duty prime movers. Let's look at a specific case.

Killough Construction Company of Ottawa, Kansas, owns one rock crusher and circulates it between six quarry sites it leases in the eastern part of the state. Two operations are involved: handling rock to feed the crusher and the crushing operation itself. GM diesels power all the equipment. This standardization makes servicing easier and cuts the necessary part inventory.

Crushing equipment consists of a Cedarapids hammermill with a GM 4-71 operating conveyors and screens, and a Twin 6-71 mounted on a small truck operating the mill itself. A Cedarapids 22-in by 36-in primary crusher is driven by a GM 6-71 engine. Two ¾-yd shovels constitute the handling equipment.

One shovel, a Northwest, was the last item to be dieselized. A Series 71 diesel replaced a gasoline engine and according to Robert Killough, company president, the shovel's work capacity was increased 25% while its operating costs were cut one-third. Now fully dieselized, the plant turns out 125 ton of stone per hour.

RUSSIAN farm delegates visiting our agricultural areas were reported to be impressed with our high productivity per individual farm worker. We've known the answer for years—mechanization.

Tractors are the primary tool of the farmer, and the number in use grows steadily. Even this is not a true picture because the amount of work obtained per unit is a big factor. Work capacity has steadily increased too. Perhaps it is not coincidence that there has also been a steady increase in the number of diesel-powered tractors.

Mention a diesel tractor, and many are prone to think in terms of the big crawlers that pull huge harvesters and combines. This may have been true at one time, but no more. Wheel-type units are built in comparable sizes with a choice of gasoline or diesel power. Apparently the choice is swinging to diesels because some farm tractor builders report growing percentages of diesel-powered units to total output.

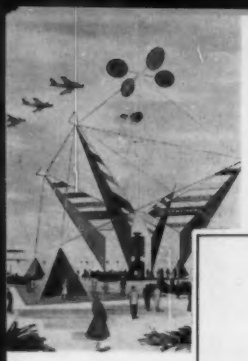
Modern tractors are versatile and farmers are finding more and more jobs that they can do. As the utility factor goes up, the savings inherent in diesel operation becomes increasingly attractive. Add to this the ability to do more work per hour or day, plus the longrange dependability of diesel power, and you have a good proposition.

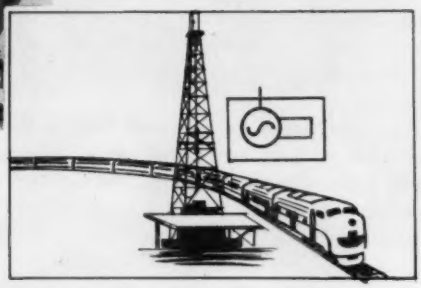
An Oliver Super 99 tractor with a Detroit Diesel 3-71 engine will pack three centuries of plowing into 26 days at the Powerama. But this is the story behind the story, so let's see what this tractor does in actual use on the farm.

Verne Robinson, a farmer near Coral, Michigan, was one of the first in his state to put this Oliver tractor to work. Using a 5-bottom, 16-in plow pulling a clod buster, Robinson was able to plow and drag simultaneously 28 to 30 acres per day. His diesel fuel consumption averaged 1 gal per acre, which he bought at 14.9 cents per gal.

During the summer months, the tractor utility increases as its engine doubles as power for an irrigation unit. Parking the tractor at a well, the engine drives a pump delivering up to 900-gpm water at a lift of 40 ft, developing a pressure of 125 psi.

Mr. Robinson likes the economy of a single piece of equipment that gives him power to both plow and pump. Plowing and dragging triple the acreage formerly worked per day in one operation, and gives him more time for other work or to just plain enjoy life.





Electro-Motive Division

FIGURES will substantiate that:

> "Diesel-electric locomotives do one-third more work at about one-half the cost of steam locomotive operation."

Electro-Motive Division of General Motors built its outstanding success in the conversion of railroads from steam to diesel-electric power on the truth of this statement. We know it's true, you know it's true, everybody knows that. Yes, now!

In the early days, gasoline-electric rail cars were the only railroad equipment powered with internal combustion engines. There were no diesel figures—only faith. And it was this faith that had to crack a traditionally "tough" industry that loved its steam engines. It took faith even to see the potential of diesel-electric drive because early locomotives were not the refined type of equipment that they are today.

The job was done. First came the articulated streamliner, the PIONEER ZEPHYR, with its GM 201A diesel engine. But diesel-electric railroading as we know it today started with the concept of the separate locomotive. The "unit" idea started at the same time with the first units, "511" and "512", coupled together to make a 3600-hp locomotive.

From the start of EMD's La Grange, Illinois plant, in March 1952, locomotive design and all the component parts have been under continual review and improvement. Passenger, freight, and switcher locomotives have been redesigned and refined for greater utility and efficiency. To meet higher horsepower needs, the "201A" engine gave way to the "567" series.

An EMD "Parade of Progress". Early 1924 model Northern Pacific rail car is followed by a later rail car, an early streamliner, and a modern unit.

This brand new 2400-hp high-speed Union Pacific passenger locomotive will show Powerama visitors EMD's most modern conventional locomotive in a "drive-it-yourself" display.

Product refinement has a big effect on user costs. Consider these improvements in engine component service life: early piston rings ran 40,000 to 50,000 miles—now they are running about 600,000 miles; connecting rods and main bearings once good for 100,000 miles now run a million miles.

Electrical equipment has been greatly improved. Design changes and better insulation have boosted permissible traction motor ratings by at least 20% to 30%. Dynamic braking effort has increased over 23%.

With full realization of the effect that parts availability and service facilities play in user costs, EMD has set up a network of branch warehouses to stock parts, plus factory branches for rebuilding major components. They established a "Unit Exchange" system as a means of reducing downtime. The final back-up is a factory rebuilding and modernization service at La Grange.

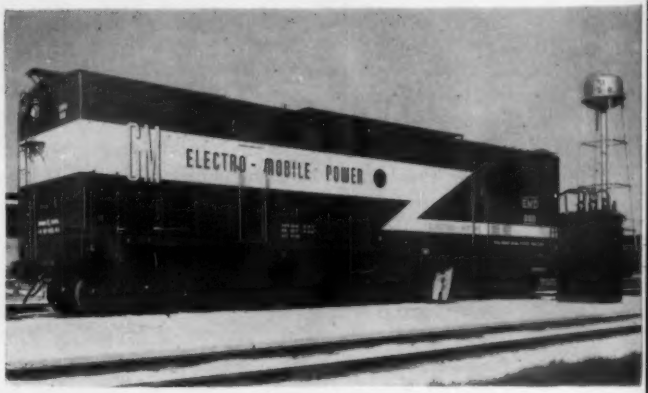
EMD has always followed the policy that any improvements incorporated in new production should be designed to permit incorporation in older units. This means that the railroads can update equipment with new parts, rebuilds at the factory branches turn out the equivalent of new components, and that the factory can rebuild old units with performance and life equal to that of new units.

Today, railroads are completely dieselized or are rapidly approaching it. This reflects in demands for new locomotives. As a commentary on this and also on the number of EMD units in service, the requirements for parts by users and EMD's rebuilding facilities have been higher than that for new units for more than three years.

To insure full utilization of its manufacturing facilities, EMD has diversified. Last fall it introduced its "Electro-Mobile" power units, compact, portable, and mobile diesel-electric generator sets in 500-, 750-, and 1000-kw sizes. This year came the announcement of a portable diesel-electric power package for the oilwell drilling industry. At the Powerama they will show for the first time their new lightweight high-speed passenger train and locomotive.

There's a touch of irony here. EMD cut its teeth on the gasoline-electric rail cars that railroads used for cutting costs on branch and feeder-line passenger service. High gasoline prices made them unprofitable. Early diesels did not fit rail cars but did make possible the articulated passenger streamliners.

Today, rail cars are having a resurgence, powered largely by EMD's sister division, Detroit Diesel. Now, EMD is again concerned with specialized, high-speed passenger trains. This would seem to prove one thing; early concepts of the best and most economic means of mass transportation were sound, but it took years of engineering improvement in diesels and other components to make them practical.



EMD's fully-equipped 1000-kw packaged power plant for electrical service, where you need it, when you need it.

Electro-Mobile Power Units

LAST October, Electro-Motive Division introduced its "Electro-Mobile" power units. This was a step in its carefully planned diversification of products program to maintain full utilization of its extensive manufacturing facilities. This new line of EMD products, consisting of completely integrated diesel-electric generator sets—350-kw and 500-kw highway units and 750-kw and 1000-kw rail-mounted units—was aimed squarely at utility service.

Expanding use of electricity per capita, population growth, and the trend toward decentralization both commercial and residential, are all tending to make the utilities' power distribution problems still more difficult. EMD feels that it has the answer to a lot of these headaches in its Electro-Mobile units. Here's how they help.

The basic distribution problem lies in the fringe areas. Single, long power lines are subject to voltage drops and are also vulnerable. On the other hand, second lines are expensive. Electro-Mobile units can be used for voltage boosting, curing this trouble. Located out on the end of the line, they serve as an alternate source of power, assuring continuity of service and deferring the expense of a second line.

Peak-skimming is another "natural" for these units. Again, they make possible the deferment of heavy capital expenditures as would be necessary to supply peak requirements, perhaps of short duration. The Powerama itself offers an excellent variation on this theme.

Brilliant night lighting and the heavy day and night exhibit-operating demands at the Powerama will require up to 4000 kw. In this location, the nearest substation of Chicago's electrical utility, the Commonwealth Edison

Company, is two miles away. Also, temporary power lines to the site would have to tunnel under the Illinois Central tracks.

Here is a definite distribution problem. It would take a lot of time, money, and materials to provide the electrical service. Someone has to pay for it. And it is only for one month! Will the customer pay the costs or go elsewhere? Should the utility absorb all or part of the cost in the interest of good public relations? You can bet that there would be a lot of sweat before a satisfactory answer was worked out.

Actually, the problem never arose. Four 1000-kw Electro-Mobile power rail units connected to operate as one generating plant will supply the power. One of these units will be the property of Commonwealth Edison Company. Stationed elsewhere in the Powerama will be a 500-kw highway Electro-Mobile unit that has been purchased by Commonwealth Edison for delivery right after the Powerama.

It takes only little imagination to translate this case into terms of a utility's ability to supply a high standard of service to far outlying communities or in less remote areas where the mushrooming growth of industry and residents is severely taxing generating and distribution facilities.

A locomotive is essentially a mobile power plant with the facilities for not only producing power but absorbing it. On this basis, EMD has had a lot of experience in building mobile power packages. When designing these new sets, they retained a number of locomotive components. For example, the '578C' engines in 6-, 8-, 12-, and 16-cyl versions are the prime movers used.

The advantages are many. These engines embody all EMD's engine-building experience and they are in daily production. Service procedures are well known, parts stocks and distribution channels are in being, factory branch rebuilding facilities are available around the country, and the "unit exchange" policy is already in practice.

A new alternator and controls had to be worked out. However, these and all the other components of the power plants closely parallel current production items both by nature and the facilities required to produce them. Car bodies, structures, accessory items, and electrical controls are nothing new to EMD.

The new "A" series of alternators were designed to match engine characteristics. All are designed to operate at 4160 or 2400 volts. They turn 720 rpm for 60 cycles, 750 for 50-cycle operation. Their design and construction benefits from the research that has so greatly improved the service life and overload capacity of the railroad main generators and traction motors.

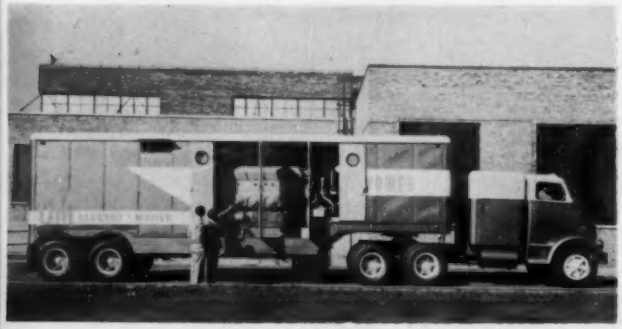
Another carryover from railroad practice is the use of multiple "block" of power. Units of standard sizes can be assembled to match the power requirements closely. The railroads have found this flexibility to be very advantageous both operationally and economically; the same will be true of utilities.

In this case, there was a short-term need for 4000 kw. When it is over, each mobile power plant could be moved to fill a separate requirement or any combination of them used as the power demand required. Each of the units has all of the regulating, metering, and protective equipment necessary to phase right in on a "hot" power line.

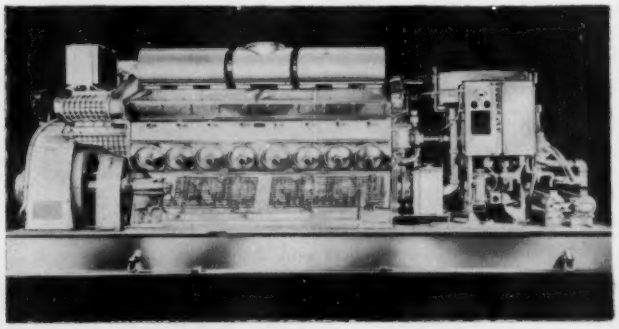
Special automatic controls can be provided to get the units on the line in response to remote starting impulses. Action can be initiated by pushbutton, radio, telephone, voltage relay, or carrier current, as desired. Utilities will be able to use this operational flexibility to great advantage. And they will like the price tag too.

There is a tremendous potential use for diesel generator sets in the utility field. As in the case of the railroads, utilities are steam-minded and also think in terms of central station power. This is fine for the big power grids, but trouble is building up in the big fringe areas. EMD has set out to show them what diesel power can do to help solve their problems.

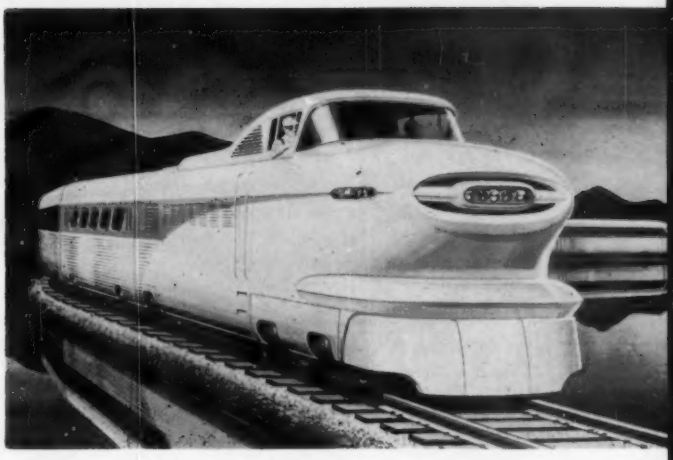
500-kw EMD diesel-electric trailer-mounted mobile unit helps utilities protect and improve service in far outlying areas.



Portable 1000-kw diesel-electric generating plant is easily transported on skids to semi-permanent or long-term locations.



"Aerotrain" Designed by EMD to Cut Carrying Costs



IT'S no secret that railroads are losing money on passenger service. Despite the substantial economies that were effected by the rapid switch from steam to diesel-electric locomotives, passenger service is in general a losing proposition. At least with conventional equipment.

The relatively high investment in equipment per passenger, and the cost of the service required, makes it next to impossible for this service to be self-supporting on present fares. Competition from other carriers does not help the situation at all. Alert to the situation, the railroads are trying to do something about it.

Various railroad presidents have approached the Electro-Motive Division for any suggestions it might have for new passenger-hauling equipment to:

Reduce equipment investment per passenger carried
Reduce operating and maintenance costs
Lower car center of gravity for higher average speeds
Improve riding comfort.

The first two items would reduce costs, greatly reducing the deficit. Lower fares might be possible which, together with the last two items, would be incentives for an increase in passenger traffic.

EMD accepted the challenge and undertook the project. It was uniquely fitted to do so on the basis of its long experience in the design and building of power plants and car structures. Hundreds of gasoline-electric rail cars and thousands of diesel-electric locomotives attested to this.

The concept of diesel-electric passenger locomotives to pull conventional passenger cars have always imposed a compromise in the locomotive's design. This is due to wide variations in weight, heating, lighting, and air conditioning of existing passenger equipment. Now for the first time, EMD had a clear track.

It would be possible to select the most economical prime mover and match it to a train to obtain the ultimate in utilization and economy. The train was to consist of a single-unit locomotive and 10 coaches. All components from the main and auxiliary engines to the size and weight of the cars could be assessed on the contribution each makes to the most successful whole on the basis of performance, first cost, operating cost, maintenance, repair costs, and safety.

EMD set up an additional ground rule. In the design of the new train, existing proven components should be used to a maximum degree, consistent with the objectives of the project. This policy offered two advantages; economy would be best served by the use of components already in mass production, and reliability would be enchanced by the use of time-proven components.

As a result, the new locomotive will contain standard GM diesel engines and Electro-Motive generators, traction motors and control apparatus used in thousands of GM locomotives throughout the world. Basis of the cars will be an adaption of the present body of GMC Truck and Coach Division's 40-passenger inter-city-type highway coach. Air conditioning will be from Frigidaire Division. Auxiliary diesels for train heat and air conditioning from Detroit Diesel, and the auxiliary generators from Delco Products Division.

Design of the new coaches represents a new philosophy. A big element in the railroads' losses in present passenger service is the drain of repair and refurbishing of cars to keep them habitable and attractive to the public. EMD has evolved a new type of car with the body so low in first cost, that when compared with conventional cars it can be regarded as expendable.

The car's undercarriage is made with unusual stamina for long life and with no emphasis on styling. Consequently, it will need relatively little attention. Car bodies, in contrast, while far exceeding governmental and AAR requirements for safety, are cheap enough to be replaced rather than refurbished. It is believed that this can be done at lower cost.

Present average life of a railroad coach between complete overhauls is seven years. Thus, railroads would have the opportunity to come out every seven years with a train having new styling, new comfort and safety features, without added expenditure.

The GMC coach body has been widened 18 inches for more comfortable seating space, and a wider aisle is adapted for the new coach. Vestibules replace the

driver's compartment and engine space. One end contains a lavatory and a pantry for serving meals. The other end will be a vestibule with entrances on both sides. Doors and steps handle variation in platforms.

The whole body is mounted on a 4-wheel underframe meeting all railroad operating necessities. Suspension is completely air-ride, with many of the members interchangeable with the inter-city bus equipment. Passengers will literally ride on air with no through-metal impacts. The new ride concept includes self compensation around curves in which the car floor and axle are parallel.

Passengers will ride higher than in other lightweight trains for a more enjoyable view. Despite this, the center of gravity is only 45-in above rail compared with 55-in of standard railroad coaches. The baggage compartment is under the floor as in the case of buses.

Cars are non-articulated and all connections are automatically coupled when the cars are brought together. Two 4-passenger cars, equivalent to an 80-passenger 65-ton conventional coach, weighs approximately 30 ton. When tooled for volume production, it is expected that the new cars could be sold for $900 to $1000 per seat. Present newest coaches average $2250 per seat. Cars are 40-ft long; 10-ft, 9-in high; and 9-ft, 6-in wide.

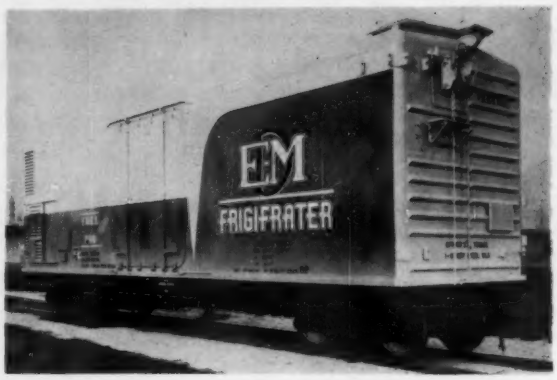
The locomotive, only 53-ft long and 13-ft, 7-in above the rails in height, will have one 12-578C GM diesel engine with 1200 hp for traction. The front 4-wheel truck is the driving truck with two traction motors. A 2-wheel idler axle sustains weight at the rear of the locomotive. The two auxiliary GM 6-71 engines with Delco generators in the locomotive supply current for train heating, lighting, and air conditioning.

Gearing will provide for a top speed of 102 mph. Light weight and low center of gravity will permit much faster average speeds than attained by present equipment. Dynamic braking provides the economy of electric braking for controlling speed on long grades.

Locomotive fuel consumption is approximately 1.3 gpm at top speed with full load in level country. At the present price of fuel oil delivered to a train in Chicago, this means that 400 persons could be hauled from Chicago to New York for approximately $125 worth of fuel, or about 35 cents per passenger.

The locomotive and 10-car, 400-passenger train can be hauled at 100 mph by a single 1200-hp engine. To duplicate this performance with present passenger coaches would require two of the same 1200-hp engines in the E9 high-speed passenger locomotive.

If present trends continue, it is indicated that the greatest passenger traffic opportunity of the railroads lies in the direction of rapid mass movement of people at very low fares and very low costs. EMD's experimental project points squarely in this direction. Although they have no intention of regularly building the entire train, EMD will build standard lightweight locomotives of this design as part of its regular line.



Refrigeration on the Move

ANOTHER Powerama "first" is Electro-Motive's new mechanically refrigerated railroad car, the "Frigifrater". Several major engineering advances—in refrigeration equipment, insulating materials, and car body design—should make this a valuable tool for refrigerated transportation.

Products in the sealed lading compartments are kept both cold and moist by cold-wall refrigeration. Temperatures can be held anywhere between 10°F below zero to 65°F above. Blowers feed captive refrigerated air through ducts around the all-steel, all-welded cold-wall lining. Defrosting is cut to once every seven days.

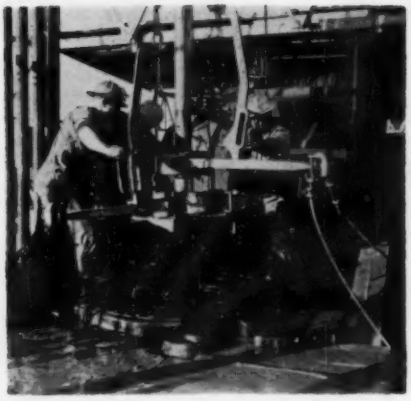
EMD designed the diesel-electric power unit for compactness and minimum servicing. This was done by eliminating many relays, voltage regulators, starters, charging generators, and other electrical items.

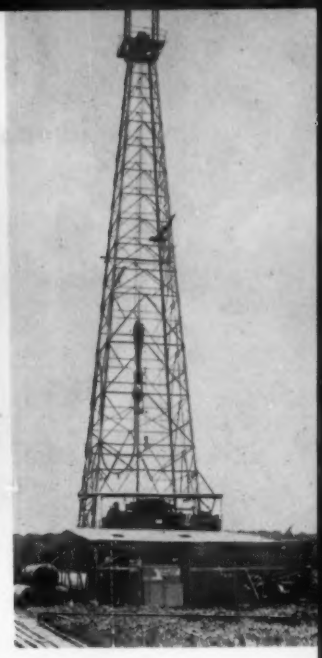
Insulation between the car body and the inner cold wall is an inorganic foam that bonds itself to both surfaces. It will not pack down even under great pressure and adds greatly to the structural strength of the car.

The whole car body is separate from the steel underframe. Fiber supports and cushioning devices permit free sliding (within practical limits) for protection against damaging shocks. Also, the entire refrigerated unit can be lifted, still operating, from the underframe for transfer to other transportation; aboard ship, for example.

Another feature was aimed at more efficient materials handling. Special doors open out only 13 inches and then roll back along the side of the car to minimize door interference. An 8-ft opening is provided instead of the conventional 4-ft width, permitting the use of fork lifts. Special locking devices and insulation prevent refrigeration loss.

Diesel-Electric Power for Drilling Rigs





Use of skid-mounted diesel-electric power-packages featuring the dependability, compactness, light-weight and extreme control flexibility developed in EMD locomotive units is now extended to the oil well drilling industry where these characteristics also apply.

PACKAGED diesel-electric power for oilwell drilling rigs—that's the latest item in Electro-Motive's product diversification program. Why pick out this field? Quite a switch for a locomotive builder, isn't it?

Actually, no. When you analyze the requirements, you will find that this is another case where the principles and products of EMD, the diesel-electric locomotive builder, can be applied to a different field to excellent advantage and with a minimum dislocation of manufacturing facilities. And of course, there is a good potential market.

Let's see where the parallels lie between locomotive design and equipment and those of a power package for oilwell drilling. First, dependability. Locomotive road failures are costly things. But so is a failure in a drilling rig; the rotary table, mud pumps, etc., must be kept going. Continued operation at reduced power is possible in the rare event of the failure of one engine.

Now, space. In locomotive design, a lot of power must be packaged in a small area and all accessory equipment must be included. Machinery design must provide some freedom in location of all component items, both in order to get a fit in the available space and for proper weight distribution. And each factor here also applies to drilling rigs.

Land-based rigs may not be up against the space item —when set up and drilling. But they have to move and then compactness with a low weight-to-horsepower ratio becomes important. The overall dimensions and weight of each unit of the package become limiting factors in rail and highway transportation. There is also the matter of loading, unloading, and general handling.

Offshore rigs intensify the importance of all these factors. Space and weight must be carefully considered because of their effect on barge or platform size and design. Locational flexibility, enhanced by the diesel-electric drive, permits maximum latitude in weight distribution.

Locomotives require extreme control flexibility. This has been provided by using DC circuits that give high torque along with accurate speed and power control. Control is also centralized. Such ease and flexibility of control is highly desirable for drilling rigs too.

Further parallels lie in the equipment used in both applications. Basic units of the drilling rig power package consist of the 8- or 12-cyl 567C 2-cycle engines used in railroad service. Here they are rated 875 hp and 1310 hp respectively. These are skid-mounted with two generators, a generator control cabinet, and engine cooling apparatus.

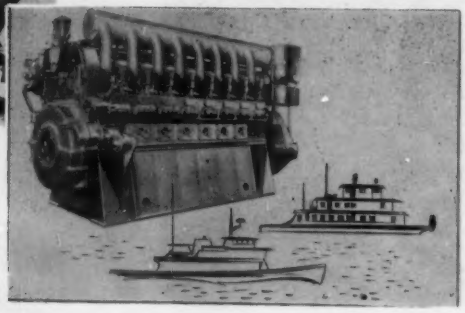
Generator power is applied to 625-hp motors, which singly or in pairs supply power for the draw works, mud pumps, and rotary table. These motors, like traction motors, are series-wound.

The motor control cabinet receives and distributes power to the motors. Cables are arranged for easy connection and disconnection without bolting or taping being involved. Motor control is simple, but underlying the physical aspects of control are protective relays and control circuits that function to safeguard the equipment. Various motor-generator connections meet any particular demand.

As a final parallel, these units like the diesel-electric locomotives are replacing steam. Two 8-cyl units were recently delivered to Philips Petroleum Company for conversion of a former steam rig to be used for offshore drilling. First of the units, also with two 8-cyl 567C engines and associated equipment, went to the Offshore Drilling Company and are working near Houma, Louisiana.

Petroleum * Mining * Construction * Agriculture * Railroad * Logging & Lumbering

Highway Transportation * Marine * Electrical Power Generation *



Cleveland Diesel Engine Division

Diesel engines for Naval and civilian marine requirements; Diesels and natural gas engines for all industry.

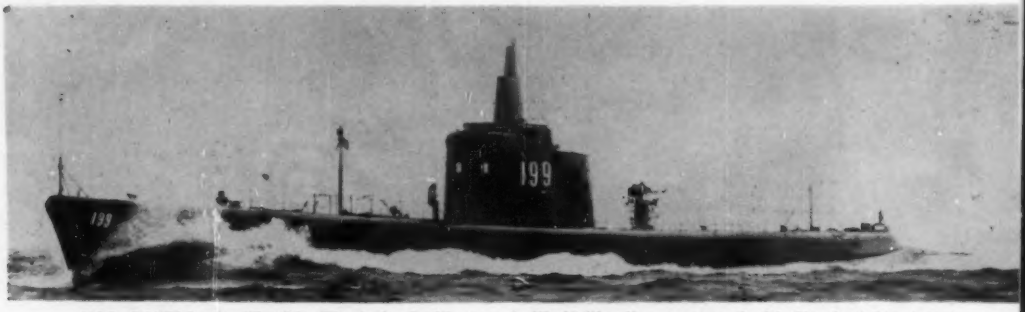
CLEVELAND Diesel Engine Division of General Motors in its 25 years of diesel engine production has produced many engines for different industries. A major portion of its activity has been the building of marine propulsion units for both the United States Navy and commercial vessels.

All Cleveland Diesel engines, like those of other GM divisions, are 2-cycle units. Three basic models have been in production in recent years: the 6½-in by 7-in Model 268A, the 8¾-in by 10½-in Model 278A, and the 12½-in by 14½-in Model 358. The three models, respectively, are inline, vee-type, and "X"-type units; the first two being built with varying numbers of cylinders. An overall horsepower range from 150 to 3000 is provided.

To these models the new Model 498 turbocharged engine, unveiled at the Powerama, must be added. This engine exemplifies the continuing research underway to produce better and more efficient 2-cycle engines with higher specific outputs, with lower specific weights.

Though Cleveland Diesel's name is usually associated with the marine industry, this is not the only industry that it serves. The Model 358, for example, was developed specifically for industrial application. This engine, along with Cleveland's other models, will be found supplying power for aluminum ore reduction, the petroleum industry, pumping applications, general electrical power generation, and others.

Two of four Model 16-278A engines, Cleveland Diesel's work-horses, packed into a World War II submarine.



U.S.S. TAUTOG, the "Terrible T" of the Pacific area in World War II, was powered with Cleveland Diesel engines.

Cleveland Diesel and the Navy

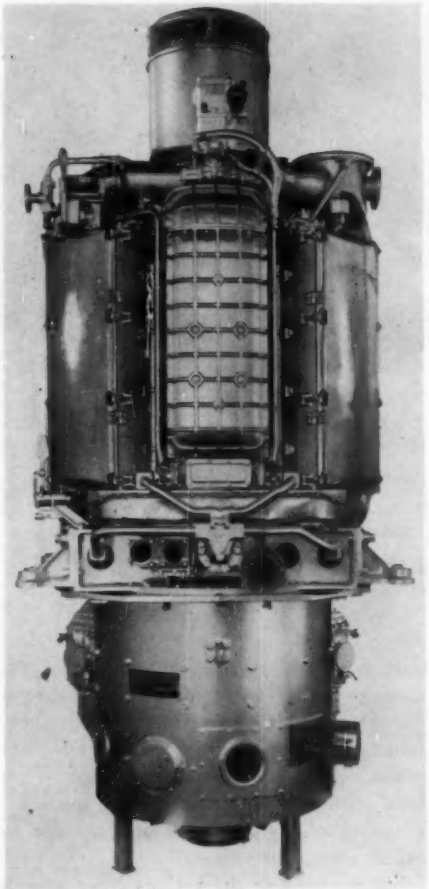
Since Cleveland Diesel took over from the Winton Engine Company its association with the Navy and its development programs has been close. They have built vast numbers of production engines and developed special models for various specific duties.

OF all the diesel horsepower produced for the Navy by Cleveland Diesel, perhaps the service rendered in the submarine program is the most spectacular and most publicized. In all, 172 submarines were powered with GM engines. Powerama visitors will have a chance to tour one of these, the U.S.S. Tautog.

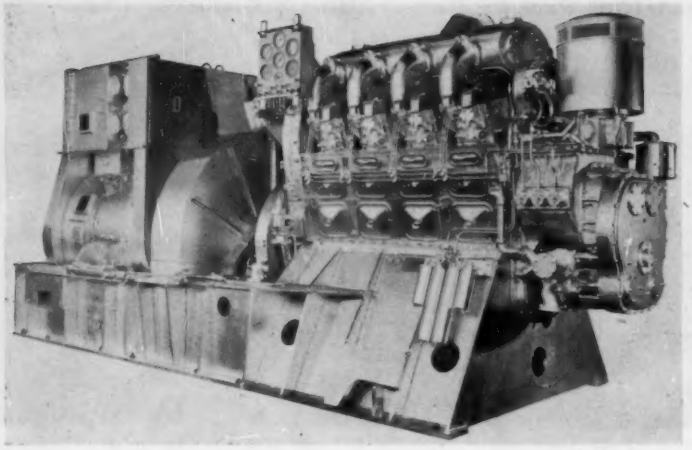
The 307-ft vessel is now the headquarters of the Naval Reserve Submarine Division 9-227 based in Milwaukee, Wis., and was brought to Chicago for the Powerama. This particular submarine is well fitted for commemorating the role of diesel engines in helping provide the tremendous striking force of the Navy.

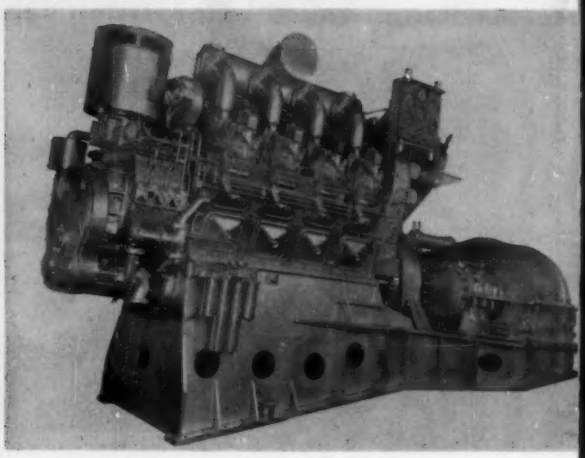
Known in World War II as the "Terrible T", she well deserved the title. In 13 Pacific patrols she sank 26 Japanese ships totaling 72,606 tons. This represents the largest number of Japanese ships sunk by any single ship. At Pearl Harbor on the fateful December 7th, 1941, she started a long and successful combat record by shooting down a Japanese plane with her machine guns.

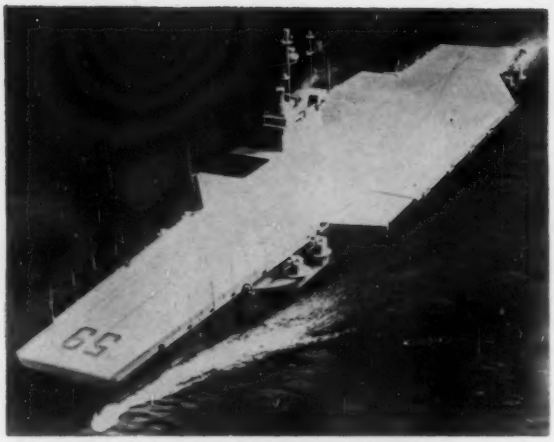
Four 16-cyl Model 278A main propulsion units built by Cleveland Diesel were installed prior to the ship's



Power for the Navy's fastest attack-type submarines of the TANG-TRIGGER class is provided by the new 16-cyl, vertical-type engine that was developed by joint effort of the Navy and Cleveland Diesel.







(top left) Special Model 8-278A engine and electrical equipment form impulse generating set for non-magnetic minesweepers

(top right) Similar engine with reduction gearing, all featuring non-magnetic construction, form the propulsion units.

Even the big ones use and depend on diesels. Three Model 16-278A-powered generator sets installed in the Navy's newest carrier, U.S.S. FORRESTAL (model shown), start automatically if main power fails to provide emergency power for radar operation, electronic devices, fire control, elevators and other equipment necessary for handling the landing and taking off of planes from the huge flight deck.

commissioning on July 3, 1940. As in all submarines, the diesels turned generators to provide electrical power for the propulsion motors while on the surface. The power also charged the batteries used for propulsion when the craft submerged.

Demonstrating improvement in submarine engines since World War II, a 16-cyl, vertical, radial-type engine is now being used in the fastest attack-type submarines of the Tang-Trigger class. Developed jointly by the Navy and Cleveland Diesel, this 2-cycle, uniflow-principle engine is the lightest diesel available in its power range. The engine is arranged in four rows of four cylinders each with 90-deg spacing between the banks. It is only about one-third the size and weight of earlier submarine engines.

Surface craft in the various Navy programs required a huge number of Cleveland Diesel engines. The landing craft program alone was enormous. Tugs, escort and supply vessels, patrol craft, and mine sweepers are a few of the types that added to diesel engine usage. While in most cases, standard marine units, or at least those built to Navy specification, can be used, it has been necessary to develop some special engines.

The best example lies in the engines that Cleveland Diesel built for the Navy's newest mine sweepers. Though similar in appearance to regular production engines, they represent two years of development so that they would be highly efficient in the detection and destruction of the new-type magnetic mines.

Anti-magnetic materials were used to a maximum degree. Features are a cast aluminum base, welded stainless steel crankcase, aluminum cylinder heads with bronze valve seat inserts, Ni-Resist guides, and welded alloy steel cylinder liners.

During World War II, Cleveland Diesel supplied the Navy with main propulsion and auxiliary machinery for 82 types of ships. Because of this, the division was given a major role in the development of this new equipment.

LAURENCE C. TURNER, one of the 25 tugs in Great Lakes Towing Company's fleet, all converted to GM diesel power since 1949.

Cleveland Diesel and the Commercial Marine Industry

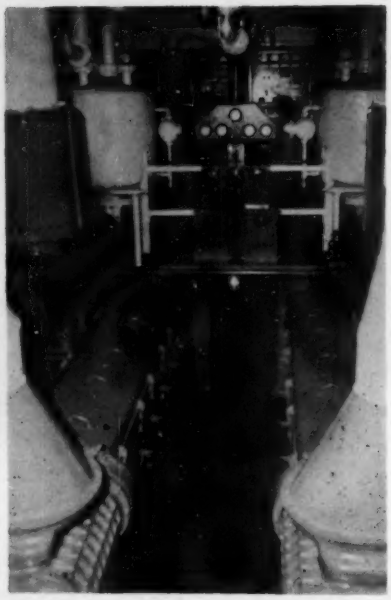
LACHLAN MACLEAY, first 4-screw inland waterways towboat, recently went into service along the Missouri River. Four 12-cyl Cleveland Diesel engines produce a total of 3600 shaft horsepower for propulsion.

SINCE Cleveland Diesel started building diesel engines, they estimate that they have powered more than 70% of the towboats operating on the Mississippi and Ohio Rivers; more than 90% of the diesel-powered tugs on the Great Lakes; and over 60% of the large diesel-powered tugs in New York Harbor.

There are two stories to tell here. The first and most obvious is that this is a nice chunk of the business for one engine builder to get. The second is that while a good deal of this business involves new vessels, a substantial portion is repowering and generally at the expense of steam power.

The fact that practically all new construction and repowering work involves diesel power shows the importance of this type of prime mover in these and other categories of marine usage. The reason for this supremacy

An impressive under-the-stern view of the LACHLAN MACLEAY's rudder and propeller arrangement. Six flanking rudders are ahead of the four propellers and the four steering rudders located aft.



Two inboard engines (shown) are vapor-phase cooled. The two outboard engines are cooled by the more conventional skin-cooling system.

is found in economy of operation, operational improvement, and high availability of diesel-powered vessels.

In June 1954, Motorship presented the results of a survey which while specific to railroad tugs, indicates a pattern that has application in other fields of usage as well. The following table outlines five case histories:

Railroad	Annual Dieselization Savings	Total Cost of Dieselization	Percent of Annual Savings to Total Costs
A	$ 668,828.26	$1,355,825	49.3%
B	428,000.00	916,000	46.7%
C	454,575.20	1,344,824	33.8%
D	492,659.00	2,412,279	20.4%
E	243,232.00	1,249,500	19.5%
Total	2,287,294.46	7,278,428	31.4%

The diesel tugs are cheaper to operate than the steamers. This results in an immediate saving. However, the higher availability of the diesels has permitted them to replace steamers on a 2 to 3, 3 to 5, and 4 to 7 basis. By eliminating some steamers and still doing the job, the entire cost of their operation is saved. Conversely, replacement on a 1 to 1 basis would permit more jobs to be handled, which would reflect in greater income while still operating at a reduced cost.

Day-in and day-out operation is proving the economic incentives as outlined here. There are substantial operational advantages too. It all explains why tugs are going diesel and why the steam-powered sternwheelers of the rivers have given way to fast, powerful, and efficient diesel craft. And Cleveland Diesel has been right in the middle of it.

One of the Powerama exhibits, the tug Laurence C. Turner, is an example of what's going on. Originally the No. 15 M.F.D., a city of Milwaukee fire tug, she was purchased by the Great Lakes Towing Company in 1952 and her conversion completed in 1954. When the Turner was rebuilt, it was not only designed for efficiency but for the comfort of the officers and crew. Her normal complement is 13. She is built for outside or over-lake towing.

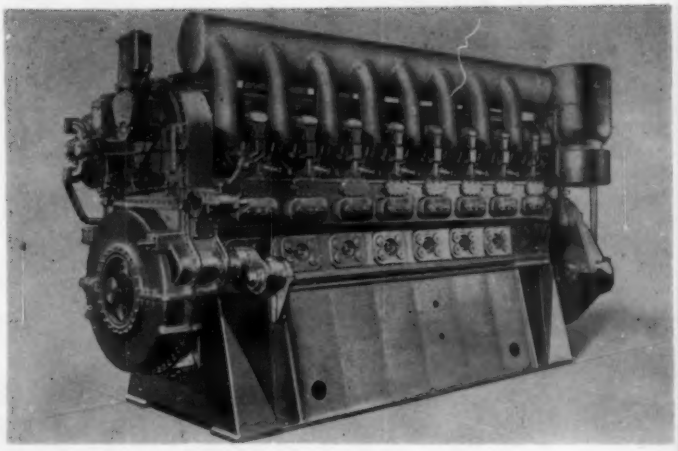
The Turner has an overall length of 118 ft and a 24-ft beam. Light running speed is 16 mph and the fuel capacity of 20,000 gal provides a cruising range of 4000 miles. Propulsion machinery consists of a 16-cyl, 2-cycle Model 278A engine rated 1740-bhp at 750 rpm. The engine drives a 1090-kw, 525-v generator to power the propulsion motor. This motor, through reduction gears, turns the propeller at 198 to 248 shaft rpm.

A feature of the diesel-electric drive is that full control is possible from the pilothouse, engine room, and after deck. The latest navigational devices are provided including radio direction finder, radar, and radiotelephone.

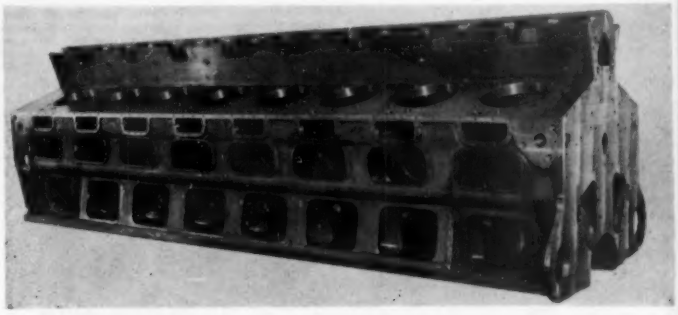
The Turner was the 25th tug to be completely rebuilt and repowered by the Great Lakes Towing Company. The program was begun in 1949 and completed in 1954. And all are powered with GM equipment.

Cleveland Diesel Turbocharges

Continuous demands of industry have been for more and more power in the same package. Originally, GM's 2-cycle engines with double the power strokes of 4-cycle types were an effective answer. Four-cycle turbocharging with higher cylinder pressures pushed up the horsepower for a given engine size. Better turbocharging then made 2-cycle turbocharging a reality. Cleveland Diesel now introduces a new diesel engine with a high specific output made possible by turbocharging.



GM Model 16-498, 2-cycle turbocharged diesel rated 175 bhp per cyl. Newly-designed, stress-relieved upper crankcase of welded steel construction for engine is below.



A turbocharged vee-type diesel engine is the latest development of the Cleveland Diesel Engine Division of GM. It will be seen for the first time at the Powerama. It was designed to meet the increasing demands for greater horsepower by the marine and industrial markets. This new engine has a bore of 8¾ in and a 10½-in stroke, develops 175 bhp per cylinder, and will be built in 6-, 8-, 12-, and 16-cyl sizes.

Cleveland Diesel points out that the new engine offers four distinct advantages of great importance to the fields of diesel application. These features are lower initial and installational costs per horsepower, lower operating costs due to higher efficiency, and much lower maintenance expense per horsepower.

The new Model 498 engine, compared with a non-turbocharged engine, develops 60% more power per cu ft of engine volume. Horsepower per pound is increased by the same percentage. It has been determined throughout tests on the engine that it is free from any appreciable torsional vibration over the entire operating range.

Thermal efficiency of 36% has been obtained through turbocharging. A series of tests showed a flat fuel rate curve from 50% to 100% load at any operating speed. Furthermore, these tests have shown that by arranging the exhaust-driven compressor in series with the engine-driven positive-displacement blower that acceleration is exceptionally good and with a clear exhaust.

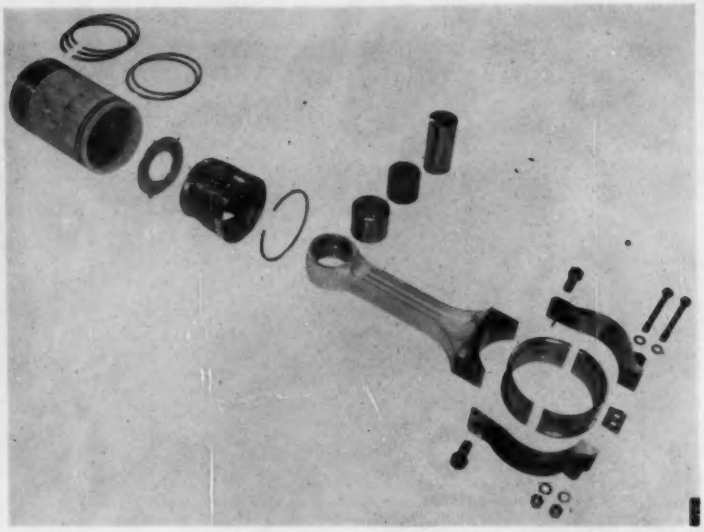
At rated speed, fuel consumption is 0.360 lb per bhp hr, with 0.380 per bhp hr the maximum fuel consumption from 50% to 100% of the horsepower range. Lube oil consumption is 0.02 gph per cylinder, or more than 6000 bhp hr per gal at rated load.

All engine parts are readily accessible for inspection or removal. Cylinder heads, pistons, and liners can be serviced individually and with ease. Fuel and lube oil piping was located with this in mind.

The fabricated crankcase is designed so that all welds are stressed less than 5000 psi, indicating a generous margin of safety. All stress-welds are designed to permit continuous submerged-arc welding during fabrication. The completed crankcase is stress-relieved and shot-peened to reduce stress concentrations.

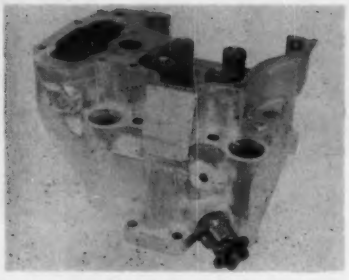
Removable fretting rings between cylinder liners and crankcase eliminate "wear out" of the crankcase for this reason during the life of the engine. Another protective feature is the elimination of crankcase corrosion by containing jacket cooling water in the liner jackets' heads and connecting piping.

Provisions have been made for spherically-seated cylinder and main bearing bolts, thereby eliminating studs.



Piston and connecting rod assembly. The pistons are full-floating, symetrical and cooled by oil jet spray. Strap construction at rod's big end facilitates removal.

Cylinder liner for new engine is stronger and more wear resistant. Titanium alloy cast iron was selected for these features.



Cast cylinder head of new design has symet rical water passages around valves and injector. Note spherical-seating for head nuts.

Serrations at the mating faces of main bearing saddles and caps insures alignment making dowels unnecessary.

Crankshaft pins and main journals were sized to provide reasonable bearing loads despite the higher cylinder pressures. Induction-hardened to 50 Rockwell C, journal surfaces mate with steel-backed, lead-bronze bearing shells with a lead-tin overlay. The camshaft, camshaft bearings, rocker arms, the arm bearings, and rollers are conservatively sized assuring rigidity and durability.

A floating-type piston with an internal carrier is used to obtain complete piston symmetry and therefore uniform thermal stress distribution. Ferrox-filled compression rings were adopted with the idea of increasing ring and liner life. Low piston temperatures are maintained by oil spray jets.

Wrist pins and bushings are sized for the additional firing pressure. The bushing is carried in a hardened steel sleeve in the connecting rod eye so that should a bushing wear through, no wear will occur in the rod proper. Force feed lubrication is supplied through a hole drilled in the connecting rod.

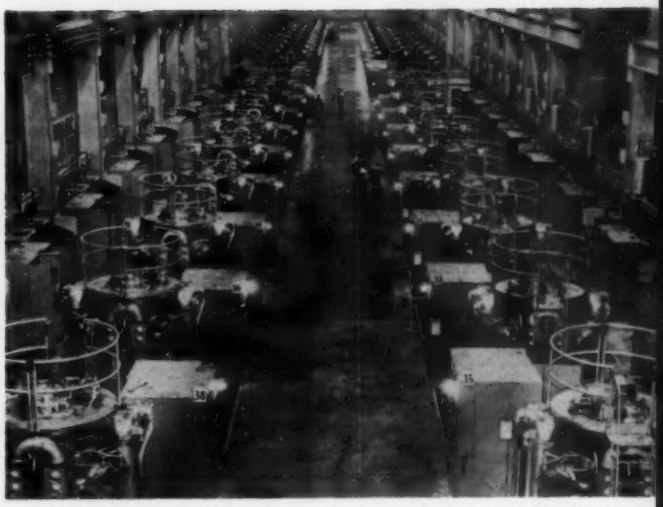
The connecting rod is very rigid. Its lower end is designed with strap construction for easy removal from the crank pin. Serrations in rod and straps insure proper alignment.

Stronger, more wear-resistant cylinder liners of a newly patented titanium alloy cast iron have been developed to reduce liner wear to a minimum. Results are evident not only in reduced liner wear, but also in greater piston ring life and reduced lube oil consumption.

A final noteworthy point concerns engine noise level. Turbocharging has reduced the overall noise to a level much below that of corresponding non-turbocharged engines.

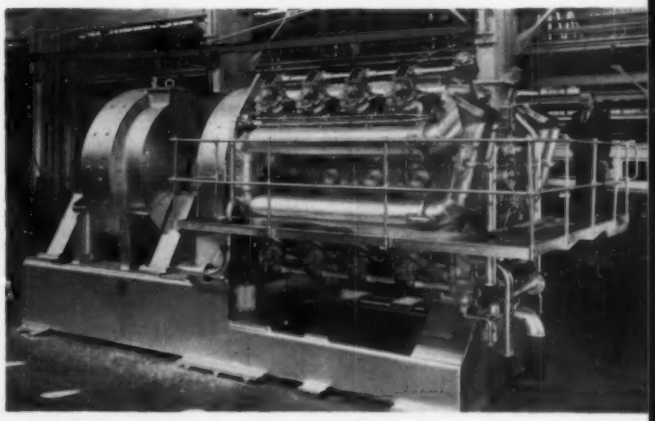
Cleveland Diesel and General Industry

All of Cleveland Diesel's marine engine models are found in industrial applications. Only minor modifications are necessary to convert from one service to another. Plus this, the big model 358 engine was designed specially for industrial use with various types of fuel.



Cleveland Diesel natural gas engines in the Reynolds Metals San Patricio, Texas, plant where they produce electricity for electrolytic aluminum ore reduction.

Below, a horizontal version driving centrifugal compressors for the pipe lines.



LARGEST of the Cleveland Diesel Division's engines is the 16-cyl X-type Model 358. This loop-scavenged, 2-cycle engine with its 3300-hp rating was developed for industrial applications. Engine, generator, and base of the vertical-crankshaft version weighs about 110,000 lb, has a height of 25 ft, and is 12 ft in diameter.

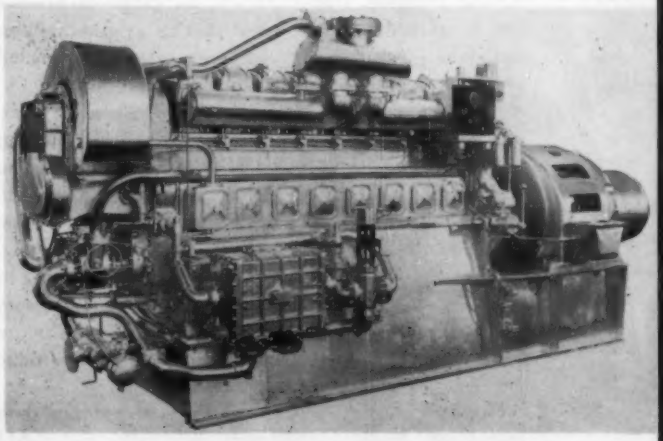
First application of these engines took place at the Reynolds Metals San Patricio, Texas plant where 42 units were installed to produce DC power for electrolytic aluminum ore reduction. These spark-ignited, natural-gas-burning engines supply power for the pot lines and each generates sufficient electricity to produce 6900 lb of aluminum per day.

In the past two-year period, Cleveland Diesel reports that the average load per engine was maintained at 95% of its total generator capacity. Less than 5% of the total operational hours during this period was used for maintenance. Now a horizontal version of the engine is to be used in the same service.

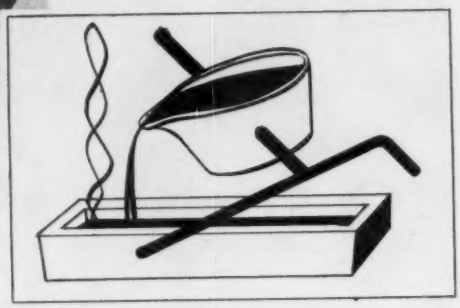
By use of a specially-designed sub-base, the engine is mounted horizontally with the shaft line sufficiently above floor level to permit access to the two lower cylinder banks. An engine of this type, in fact the one on display at the Powerama, will shortly be installed at the Port Lavaca, Texas plant of the Aluminum Company of America. There it will produce electric power for the pot lines.

Another such engine will have a turbocharger attached. This engine, with speed increaser and centrifugal pump, is especially designed for use on gas transmission lines, petroleum product pumping, chemical processing plants, and natural gas recycling.

Cleveland's standby power applications are numerous. Western Electric installed many of these Model 8-268A units as standbys in telephone exchanges.



Marine * Highway Transportation * Electrical Power Generation * General Industry



Fabricast Division

All types of light-alloy castings and heavy-alloy precision investment castings for other GM divisions and non-allied industry.

GM divisions use a lot of light-weight castings in their products. They are all alert to the weight-saving possibilities and improved performance of some components made possible through use of light-weight alloys. The job of supplying most of these castings to 20 GM divisions is handled by GM's Fabricast Division. It also supplies several non-allied firms with castings.

It's no wonder that in coping with all the complex and different needs, Fabricast has become very versatile and one of the largest producers of light-alloy castings. In addition, it produces precision castings of heavy, heat-resistant alloys for such service as jet turbine blading.

Before gaining status as a GM division in 1950, Fabricast was operated as a single-purpose aluminum foundry by Delco-Remy Division and later as a plant of the Allison Division. Under Allison, its range of products was broadened, with the result that its original molding technique of sand casting has been extended to include practically every known molding process.

Molding techniques now include green and dry sand molding, permanent and semi-permanent molding, plaster, C-Resin and shell molding, die casting; and for the heavier alloys, precision investment casting. This broad array emphasizes the fact that there is no one best method of casting for all types of jobs.

The type of casting to be made, its size, intricacy, the alloy to be used, and the number to be made are some criteria governing the selection of the casting technique. Final selection reflects the technique that will produce the best casting at the most reasonable cost.

Castings produced by these various techniques range from tiny bicycle engine heads to intricate and sizable castings for jet engines, earthmoving equipment, locomotives, army tanks, trucks, buses, and diesel engine components—not forgetting automobiles. Typical diesel components include bell housings and gear covers, manifolds, elbows, inspection plates, and crank pans.

Cylinder blocks and heads are also built for Detroit Diesel. Of course, production engines use cast iron blocks and heads, but some engines for specific purposes are built of aluminum. An example is the GM "110" engine built for use in the Budd rail cars. Some special "71" engines also use aluminum construction, and of course research in this direction is always underway.

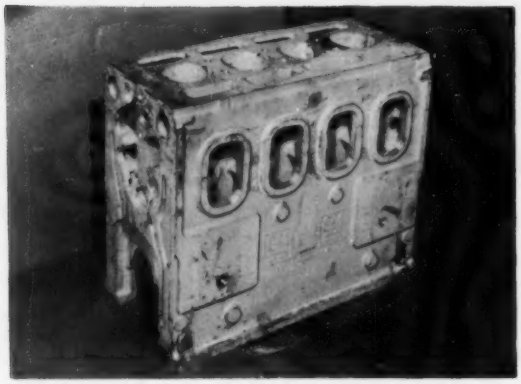
Allison Division uses a lot of aluminum castings. Large complex transmission housings such as those used in the Army tanks are frequently aluminum castings. Torque converter elements are well adapted to the casting process. The complex blading of the elements would be very difficult to form by any other fabrication process.

Emphasizing the range of castings supplied a single division, EMD gets the crankcase inspection covers used on all their engines. And it also gets the big fans and fan frames which when machined and assembled, form the hatch fans for cooling the diesel-electric locomotives.

In each instance, the molding technique used is selected on the basis of the criteria given. When complicated coring is necessary, sand coring is commonly used. Large-size and relatively small production runs would also be influencing factors. Transmission cases, the cooling fans, cylinder blocks and heads are examples of jobs for sand casting.

Permanent molds are suitable for longer production runs and save the expense of making sand molds from patterns for each piece. When coring is involved, a combination of permanent molds with sand cores may be used.

Die casting is very effective in combining maximum strength in areas of stress with the desired light weight,



Special aluminum block for a Detroit Diesel 4-71 series engine typifies some of Fabricast's intricately cored sand castings.

Complex dry-sand core used in conjunction with green sand molds to produce aluminum alloy transmission cases for army tanks.

and all at a nominal cost per piece. Volume production is necessary to offset the cost of dies. Also, the shape of the piece must be such that once the piece is cast, the die halves can be opened.

Other types of molding are used as they apply to the job at hand. In general, they are the outgrowth of two needs. The first is to produce cheaper castings by reducing molding costs. The second is to produce certain results not obtainable by more conventional molding methods. An example of the latter is the investment or "lost wax" casting technique.

With this molding process, it is possible to cast pieces to very close tolerances and with good finishes. By eliminating the need for subsequent machining it is possible to produce very complex shapes, very difficult to machine; and to produce shapes cast in tough alloys of the non-free-machining class. A good example of its use is in the production of blading for jet turbine wheels, etc.

This process starts with a very accurate permanent mold. An exact duplicate of the piece desired is made by injecting wax into the mold. The hardened wax pattern is removed, coated, and placed in a canister that is then filled with a slurry. As the slurry dries, it hardens. When it is set, baking takes place; at which time the wax pattern is burned out, leaving a perfectly shaped cavity. Molten alloy is poured into the cavity. A perfect duplicate of the original is thus produced.

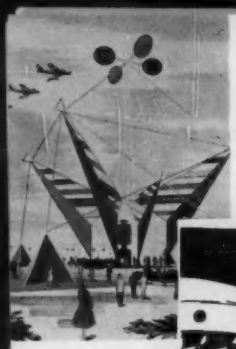
Molding is only part of the casting technique. Metallurgical control is also necessary. Fabricast has extensively equipped laboratories for analyzing and testing metals. Chemical analysis, physical testing, metallographic examination, and spectrographic analysis are all used to insure that alloy specifications are correct, that the alloy's physical properties are equal to the job they are to do, and that the metal's structure has not been altered during casting.

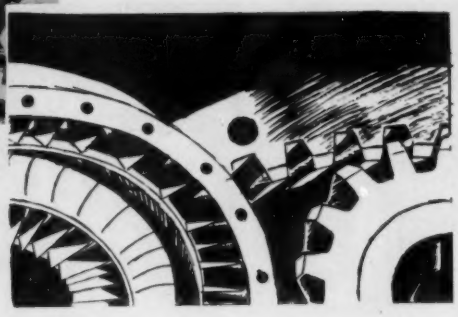
Even with all the controls and the use of the most modern methods, finished casting inspection is necessary. Visual and dimensional checks are usually adequate. In the case of investment castings, they are checked by a transcriber machine and comparator table to insure dimensional accuracy and correct contour. Zyglo (black light) is used to detect flaws not normally visible.

Since there is no single "best" casting technique or one alloy that is most suitable for all jobs, there is need for continuous research and development. Realizing this, Fabricast has provided the facilities and conducted continual experimentation with the aim of expanding the application and use of aluminum castings.

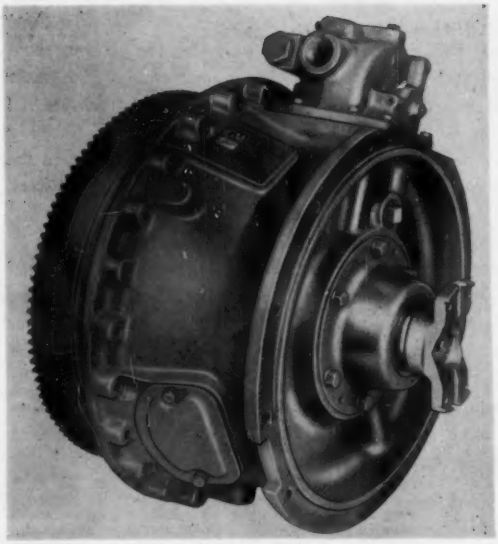
Results of continued effort in research and development have contributed materially to Fabricast's present high position in the foundry industry.

Preparing a large mold assembly. Big sand molds take up to 500 lb of molten aluminum at a pour.





Allison Division



Hydraulic converter and transmission form Torqmatic team.

IT is not enough to have good prime movers; you must apply their power efficiently. That's the role of the Torqmatic drives built by the Allison Division. Don't get the idea that this is the sole interest of Allison; it is a very versatile outfit. Turbo-jet and turbo-prop engines, propellers for the turbo-props, hydraulic actuators and motors—all are built by Allison.

Guided missiles along with commercial and military aircraft, including the spectacular Convair and Lockheed vertical takeoff fighters, thus fall within their scope of interest. Similarly, their transmission products have a broad scope of application. Ordnance vehicle applications include tanks; self-propelled gun motor carriages, including the Army's 280-mm atomic cannon transporter; as well as personnel and cargo carriers. On the civilian side, which will be the main subject here, Torqmatic drives transmit power in tractors and other earthmoving equipment, cranes, shovels, off-highway trucks, buses, rail cars, and stationary power units including oilfield rigs.

Allison has developed six series of Torqmatic converters which break down to 135 models for a variety of applications. This makes selection possible to meet a particular requirement. Such drives are helping operators to do more work at less cost in a wide variety of industries. The remarkable part of this whole development is its rapid growth; ten years ago only three successful applications existed.

First commercial application of the Torqmatic converter was the vee-drive transmission, incorporating a high torque ratio converter with direct-drive clutch for city buses. About this time, a new military transmission

Hydraulic drive lines for greater operational efficiency at reduced cost. Use the converter alone when its torque multiplication ratio is adequate or extend the ratio with "quick-shift" range gearing. Additional power takeoffs and disconnects further extend possible applications.

called the CD-850 was engineered and saw service in the General Patton tanks in Korea.

Both the vee-drive and the military transmission, still in production, incorporated the converter within the same housing as the range gearing. For greater installational and operational flexibility, it was decided that the new low-ratio torque converter and quick-shift transmission combinations would be in separate packages.

In many cases—cranes, shovels, draglines, locomotives, etc.—hydraulic torque multiplication in the converter phase and 1 to 1 torque transmission in the fluid coupling phase is adequate to meet load requirements. Then the Torqmatic converter is used alone.

For applications requiring a higher torque-ratio range, a matched converter-transmission team is used. Torqmatic transmissions have the major feature of "quick-shift" at full torque without interruption of the power. Typical applications include heavy trucks, tractors, etc.

The story of Torqmatic drives does not end here. Around the major items a great many special features and devices were worked out. Mechanical and hydraulic disconnects and clutches, positive lockups, various power takeoffs, and accessory drive arrangements are available. Another important accessory is the hydraulic brake. The design permits hydraulic braking of vehicles on downhill hauls, thus providing close speed control without the expensive wear on service brakes.

Operational efficiency and overall economy are two reasons why hydraulic drives are finding greater favor every day. Allison's figures prove it. Shipments of Torqmatic drives through the first six months of 1955 equaled the entire 1954 production!

Hydraulic Drive Lines for Operational Ease

Torque converter and semi-automatic transmission combinations work for the driver, leaving him time for his principle function—driving. This shows up in safety records. Also, equipment life is extended and work cycles speeded.

LET'S take a short ride with a neophyte driver. We pull out from the curb and while our beginner is preoccupied with the mechanics of shifting gears, a screech of brakes warns of a car that he did not see. You growl, "Keep your mind on driving, not shifting."

We stop for a light and when it flips green, the car beside us throws some quick shifts and scoots out ahead. to our driver's plaintive question about how he did that, you reply, "He knows how to use his engine power and gear splits".

Next we come to a long, steep hill and when you can't stand it any longer, you explode, "For heaven's sake, down-shift and stop lugging!" He does, but with so much fumbling that the car loses a lot of speed. Then when he lets out the clutch without enough throttle, the car stalls. Finally we get home and out of the car with a sigh of relief.

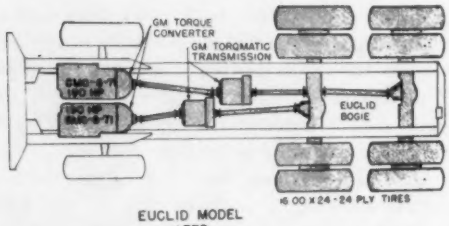
What are the lessons here? First, driving on today's streets, or the operation of any piece of equipment for that matter, is most efficient without the distraction of additional jobs to perform. Then we come to the proper utilization of engine power and range gears. Long training is necessary to accomplish this most effectively.

Avoidance of lugging involves, first of all, recognition

Euc's 50-ton dump with Torqmatic drive has increased serviceability and boosted production, all with less driver fatigue.

Climbing steeper grades out of quarry is a cinch for 10-ton Euclid with Torqmatic drive. Makes it cheaper to build grades too.

Torque converter drive in Link-Belt crane simplified control while handling loads smoothly, easily and accurately.



EUCLID MODEL
I FFD

Torqmatic drive permits ballanced power and installational flexibility in twin-engine drives.

of the condition, and secondly the willingness to go through the additional steps to correct it. This can be a real chore in some types of operation. Interruption of power just when you need it most makes gear selection and proper power application more difficult. Most significantly, road speed is greatly reduced. In each case, the need for training is evident.

Upon reflection, another point is evident—all these problems could be solved by one of the modern automatic hydraulic drives. If this is true of the passenger car, where essentially it is a convenience, think what it would mean for heavy-duty commercial equipment. Each of the items mentioned can be converted into more efficient or more economic operation.

This is not to say that truck, bus, and equipment operators are comparable in any way to our neophyte; he was just the horrible example. Those operators using mechanical drives are justifiably proud of their skill. But no matter how profiicient they become, there are inherent limitations in mechanical drives.

Modern converters or converter-transmission combinations overcome these deficiencies by applying power smoothly, matching power to load requirements automatically, maintaining power flow continuously, brake hydraulically, and generally improve operational efficiency.

Allison's Torqmatic drives are providing these same advantages to the operators of the heaviest of heavy-duty equipment. The biggest tractors and scrapers, other earthmoving equipment, large-capacity off-highway trucks, buses, cranes, shovels, etc.—all operate with an ease that reduces operator fatigue, gets more work done,

Transportation of the Army's 280-mm atomic cannon, first earth-bound atomic weapon, was neatly solved by use of two independent tractors. The problems of proper power division and balance between the two units, without recourse to complicated synchronization controls, was simply solved by use of Allison's TX-500 transmission in each tractor. Torque converters did the trick.

and cuts the wear and tear on equipment. These are three potent reasons for industry to accept these drives so let's see the results in three brief case histories.

Here's what is happening at the Castle Dome Copper Company of Miami, Arizona; John H. Gray, mine superintendent.

Castle Dome has two Euclid IFFDs and 10 trucks of other manufacturers hauling its monthly production of 350,000 ton of ore and overburden. The haul route has a maximum upgrade of 8% for approximately 4000 ft. On the same haul route there is also a 3½% grade for a short distance and a short level haul. Average length of the unit haul is 1.81 miles.

Averaging 25.3 trips per 8-hr shift, the two Allison-equipped Eucs are hauling 33% of the total production per day while the 10 other trucks are hauling the remaining 67%. Each Euc delivers almost three times the tonnage that the direct-drive units deliver.

Tire life for the GM trucks averages 17,000 miles compared to 12,000 miles for the other trucks, mainly because the Torqmatic drives prevent wheel spin which can strip the tread off a tire very quickly.

Torqmatic gives the Euclid trucks in this operation (1) increased serviceability, (2) increased production, and (3) increased tire life.

Chris Mason, superintendent of the Iron Springs Mine at Cedar City, Utah, liked the Allison Torqmatic brake which is integral with the converter.

He said that without the Torqmatic brake his trucks made about 14 trips per shift on the 7% downhill grade; with the brakes the units made 21 trips per day. The grade is 2½-mi long and the trucks with regular brakes take it at 8 mph while Allison-equipped trucks travel at approximately 25 mph.

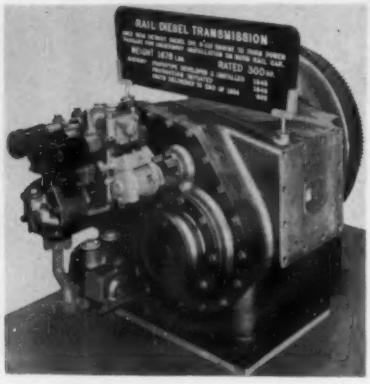
Boyd C. Paulson of the Utah Construction Company of Cedar City, Utah, was particularly impressed with Torqmatic's saving in driver training. This company almost doubled the number of drivers in the past year, which necessitated training many new drivers. Before buying trucks equipped with the Torqmatic drive, Mr. Paulson said that a clutch, transmission, or some other working assembly was lost in training every driver.

With the hydraulic drive, it is practically impossible for even an untrained driver to damage the drive-line components. This results in about a $1000 saving per driver, partially attributable to Torqmatic drives.

These three case histories were selected from many to illustrate different "plus" factors that help reduce overall operational costs. While these apply only to off-highway truck operation, similar cases could be cited for other types of equipment using these drives. In fact, others are given elsewhere; Euclid's earthmoving equipment for example.

Budd's RDCs with GM diesel-hydraulic drive are saving railroads money.

Diesel-Hydraulic Drive for Budd's Rail Cars



Hydraulic transmission used on RDCs.

Matched diesel engine-converter team, sufficiently compact for under-car mounting, put a new emphasis on rail cars. Smooth, fast acceleration, capability of high sustained speeds coupled with low fuel consumption rates and diesel ruggedness have provided the railroads with an operationally efficient and economic tool for profitable low-volume passenger service.

WHEN the Budd Rail Car was introduced, Allison Torqmatic converters and transmissions stepped into the rail car spotlight. Torque converters and fluid couplings had had tryouts in railroad service but their use was limited. Lack of power transmission capacity with reasonably sized units and the competition of well-developed electrical transmission equipment were stumbling blocks.

Small switcher-type locomotives and rail cars were the principal hydraulic-drive applications. Early rail car drives were either electric or when hydraulic were generally adaptations of converters designed for other services. In 1948 when Budd asked General Motors to design a drive, it marked the first time that a transmission was to be engineered especially for rail car use. Thus, popular adaptation of the diesel-hydraulic drive to the rail car field is a relatively recent innovation. Rail cars were given a new birth.

The Torqmatic principle, so widely applied in other heavy-duty equipment, was applied to the rail car unit. Tailored for the application, the unit surpassed earlier rail car drives in performance and efficiency. Compared to the electric drives previously used in some rail cars, it was operationally as good, reduced the weight, complexity, and space requirements, and bettered the fuel mileage.

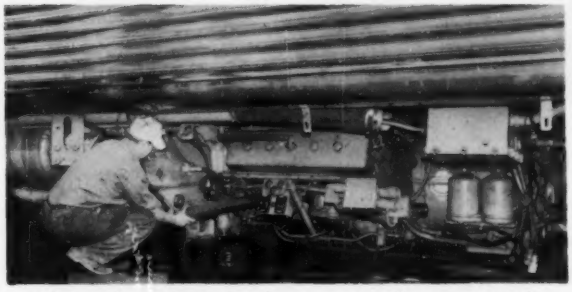
Detroit Diesel's "110" engine was combined with the torque converter into a compact under-car power package. The engine lies practically flat (15 deg off horizontal) to reduce the overall height. One power unit is located at each end of the full-sized, lightweight passenger car, and being under the car body, do not detract from passenger space.

The entire design concept was toward efficient, low-cost operation in passenger commuter service and feeder line operations. The dual engine-converter power units provide a maximum of 250 hp per car for smooth, rapid acceleration and sustained high speeds. With a full load, a car can accelerate from a standing start to 90 mph (maximum speed) in 5 minutes and cover the first 5 miles in 5 minutes.

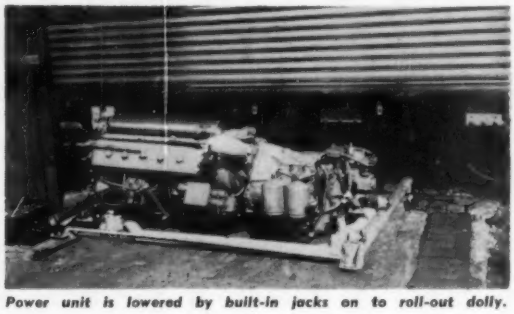
When car speed reaches 56 mph, the torque converter automatically locks to provide an economical solid drive for high-speed operation. Above these speeds, engine torque alone is adequate to meet load torque.

Single cars can be used or multiples up to 11 cars can be combined. Control is from either end regardless of the consist. This provides maximum operational flexibility

South Australian Line's RDC makes east-west crossing in 16 hours, 40 minutes. Former steam trains took 46 hours.



Disconnection prior to lowering compact undercar power unit.



Power unit is lowered by built-in jacks on to roll-out dolly.

too, including close adjustment of capacity to the load. Effect on economy of operation is obvious.

Another economic factor is ease of maintenance. Each engine-converter unit is rubber-mounted with 3-point suspension. All connections to the car, including the drive shaft between the converter and axle drive, are simplified for easy disconnection. Built-in jacks allow the whole unit to be lowered on to a portable carriage for lateral rollout.

All accessories become completely accessible for adjustment or replacement. A feature of the transmission design is external location of the oil pumps, control valves, and governor. When major repairs are scheduled, a spare power assembly can be installed and the car sent on its way in a matter of a few hours.

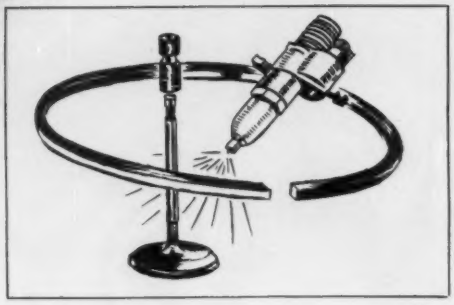
The payoff on all equipment is the cost of service that it renders compared to the revenue that it produces. Either item can change the picture for better or worse. In a recent survey, three different types of rail car drives were compared—steam train, diesel-electric, and diesel-hydraulic. Data disclosed that it cost the steam and diesel-electric rail vars 1.71 cents and 1.17 cents per train-mile, respectively. The diesel-hydraulic car cost only 0.71 cents per train-mile.

As another point of comparison, an inter-city bus costs an average of 39.7 cents per mile to operate with 37 passengers, or 1.074 cents per passenger mile. The Budd car costs 79.6 cents per mile or 0.896 cents per passenger mile with 89 passengers. One railroad has already lowered its fares to bus levels.

The 79.6 figure, incidentally, was determined as the average cost per passenger mile in a survey of the operations with these RDCs on 11 railroads. It includes all out-of-pocket and fixed expenses and is based on the railroads' average mileage of 73,000 miles per year.

Revenue is the other item of concern; passenger acceptance must be obtained. Apparently they like the fast acceleration, the comfortable ride, and the smooth stops possible with the disc-type brakes, because whereever these cars are used, passenger travel is up.

Railroads across the country, in Canada, Cuba, Australia, and Saudi Arabia are using the RDCs to good purpose. Efficient, fast, inexpensive, and comfortable mass transportation is one answer to highway congestion in crowded areas and profitable service on the low-volume feeder line runs. And RDCs are providing it with their diesels and a hydraulic drive tailored for rail car application.



Diesel Equipment Division

Builders of injection equipment, precision and specialty products for other GM Divisions.

YOU have to look hard to see the tiny 0.006-in holes in Detroit Diesel's unit injector spray tips. But GM's Diesel Equipment Division knows where they are; they put them there. It is part of their business—the manufacture of precision equipment.

Back in the '20s when Charles F. Kettering (Boss Ket) was experimenting with diesels in his first and second OLIVE K yachts, he learned that a lot of work had to be done on fuel injection equipment. He negotiated with the Winton Engine Company (later to become Cleveland Diesel Division) for a pair of engines with Winton's own unit fuel injectors. These were soon replaced with some of a different design, the forerunner of several developed experimentally at GM Research Laboratories.

For a number of years, GM Research Laboratories—primarily not a manufacturing organization—supplied GM's growing need for injection equipment with unit injectors designed and manufactured in a pilot plant. Later, the complete operation was transferred to the newly founded Detroit Diesel Engine Division. Then in 1944, the Saginaw Steering Gear Division became the Diesel Equipment Division.

This division took over the job of supplying fuel injection and other precision equipment to the other divisions. Unit fuel injectors are tailored for the engines of Detroit Diesel, Cleveland Diesel, and the Electro-Motive Division. Jet engine fuel nozzles are built for Allison.

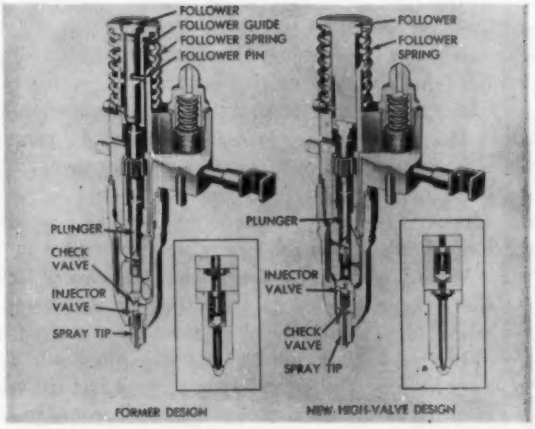
Diesel Equipment Division built a lot of unit injectors. Someone with a flair for figures computed that if one year's production were operated in engines at full load continuously for one year, they would inject 5½ billion gallons of fuel oil! Yet, injection equipment is not their sole concern.

Other products for Detroit Diesel are exhaust valves, piston rings, air heaters, and air heater pumps. For Electro-Motive they build the hydraulic valve lash adjusters and valve bridge buttons. Allison is supplied, in addition to the jet engine fuel nozzles, with variable pitch propeller controls. Plus this, some 3½ million hydraulic valve lifters per month are built for GM cars.

So Diesel Equipment Division works essentially for other GM divisions. It follows that their engineers must also work with the divisions in the development of better and more efficient components. Typical of this was the design of the "high-valve" unit injectors developed jointly with Detroit Diesel.

Objectives of the redesign were simplification of the unit injector and improvement in its service life. No basic changes in capacity or delivery characteristics were contemplated at this mite for the good and simple reason that interchangeability on an individual basis with existing injectors was desired. Delivery characteristics of then-current injectors were satisfactory and capacity requirements were met by selection of the 60-, 70-, or 80-cu mm sizes.

No external changes were made so as to preserve the desired interchangeability feature. The major internal change was the relocation of the injector valve. In the earlier models, this valve and its spring were located in the spray tip where they were exposed to high temperatures and the pressures within the cylinder. It was felt



Sectionalized unit fuel injectors, both for the 71 series Detroit Diesel engine, illustrate the modifications made in the changeover to the improved "high-valve" design.

(since proven) that greater service life could be obtained if the valve assembly were to be moved up out of the high-heat zone and isolated from cylinder pressures.

This was done by moving the valve assembly from the spray tip to a valve cage above it. The check valve, formerly above the valve assembly, was moved below it into a recess in the spray tip. This solved the problem but introduced another; space had to be provided.

The required space was obtained by shortening the plunger and bushing assembly and the spill deflector. The inner contour of the injector nut was altered to accommodate the altered components.

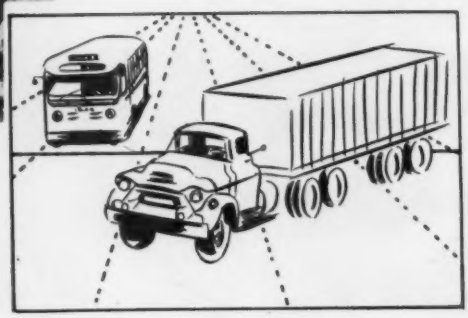
Other changes included a new 1-piece follower and a heavier, stronger follower spring. The new follower design eliminated two former parts. After thorough testing of the redesigned injector, the new parts were put into production, superseding the earlier types. But what of existing injectors?

It was realized that existing stocks of old model parts would have to be worked off. Also, users should be able to convert to the "HV" design at minimum cost. Two kits were worked out to solve these problems.

One kit permits use of the shorter plunger and bushing with the old spray tip and valve arrangement by supplying a deeper spacer. The existing injector valve nut is used.

The kit for conversion to HV operation also allows the old-style injector nut to be used. All of the new HV parts are supplied, plus a valve seat guide that holds the valve cage and seat in alignment. In new production injectors, the function of this guide is performed by the modified inner contour of the new HV valve nut.

Since matters of policy, engineering, and service are all involved in such a development, it is obvious that close liaison must exist between the Diesel Equipment Division and the divisions that it serves. However, once designs are crystallized, it can go back to its major job of turning out precision parts and components. Clearance fits of 30- to 60-millionths of an inch between injector plungers and bushings, and drilling spray tip holes in sizes from 0.005-in to 0.017-in, are all in a day's work.



GMC Truck and Coach Division

Efficient transportation for Goods and Passengers

IN only 17 years, GMC Truck and Coach Division has emerged as one of the world's largest manufacturers of diesel-powered vehicles. Conservative estimates place the number of GMC diesel trucks and highway tractors in operation in the United States today at 18,000 units. There are about 33,000 GM diesel-powered coaches.

GMC entered the diesel field in 1938 when a relatively unknown engine that burned diesel fuel instead of gasoline was installed in a single GMC truck model. Although GM engineers realized the engine was an unknown quantity, they were convinced it would succeed in actual truck operation because it was painstakingly designed for optimum efficiency.

More than 23,000 GM diesel-powered coaches are now in transit and suburban service, providing dependable, economic mass transportation.

The new engine was a 2-cycle power plant with every stroke a power stroke instead of the more conventional 4-cycle type. It far exceeded expectations. In 1939, GMC included two diesel models in its truck line and introduced diesel power in GM coaches. By 1940, GMC offered both 4- and 6-cyl diesel engines in trucks and transit coaches and demand started to increase gradually.

The engines were basically designed to permit replacement of old parts by improved components, thus never rendering the older engines obsolete by new advances. They were refined and improved by new developments until civilian production was interrupted in 1941.

When large-scale civilian production resumed in 1945, GMC brought out a larger variety of truck and bus models powered by diesel engines. Many advancements discovered during military production of diesels for the armed forces were embodied in the new civilian vehicles resulting in increased power, better all-around performance, lower fuel consumption, and greater durability.

Advancements in engines, trucks, and coaches continued at a rapid pace for the next five years and acceptance of diesel-powered trucks and buses took a definite upturn. Early in 1951, GMC diesel trucks and buses gained favor from truckers and mass transportation companies seeking extreme durability, economy, and dependability in their rolling stock.

To keep pace with the soaring demand, GMC launched an all-out program to provide the best possible diesel vehicles. In 1951 alone, many major engine improvements were made. Conventional head gaskets were replaced by direct metal-to-metal contact, a new-type vibration damper was developed, crankshafts were modified to reduce torsional stresses, a fuel modulating governor was added

for better combustion control, and scores of other advances effected. This improvement program continued unabated in 1953 and 1954 with truck and coach design keeping pace with the diesel improvements.

Progress continued in this year's GMC "Blue Chip" truck line. A great number of improvements were embodied in the 17 heavy-duty diesel trucks and eight diesel transit and inter-city coaches.

Besides the GM 4-71 and 6-71 engines, a new medium-power 6-cyl diesel with a 172-hp rating was introduced this year. Rating of the high-power 6-cyl diesel was raised from 225 to 230. Component parts were improved to give even greater durability and countless other improvements became part of the GMC lineup of diesel-powered trucks and coaches.

Although vigorously carrying out its diesel program, GMC did not neglect its gasoline models. In the 1955 truck line alone, more than 100 newly styled gasoline trucks were introduced. Many are equipped with Hydra-Matic transmissions, one of many GMC "firsts".

The coach division, introducing the revolutionary "Air Ride Suspension" to the mass transportation world, pressed its continuing development and improvement program.

From its early entrance into the diesel field, GMC has gained recognition of many of the top truck fleet operators in the country. Over 50 major fleet operators use GMC trucks powered by diesel engines.

Even though GMC has gone far in the diesel power field, the engineers and trained specialists who make up the GMC team are not content to let well enough alone. They realize that there are still new frontiers in the diesel power field to be conquered. That's their job.

Better Operation At Lower Cost

by Fred Johnson,
Operations Manager, Cooper-Jarrett, Inc.

Bold, alert management switches to GMC diesels with Twin Hydramatics and improves their operating ratio.

TODAY, with the trend toward higher wages, stiffer license fees, and increased fuel taxes, truck operators are waging a continual fight to find new operating and maintenance methods and equipment that will alleviate the cost burden.

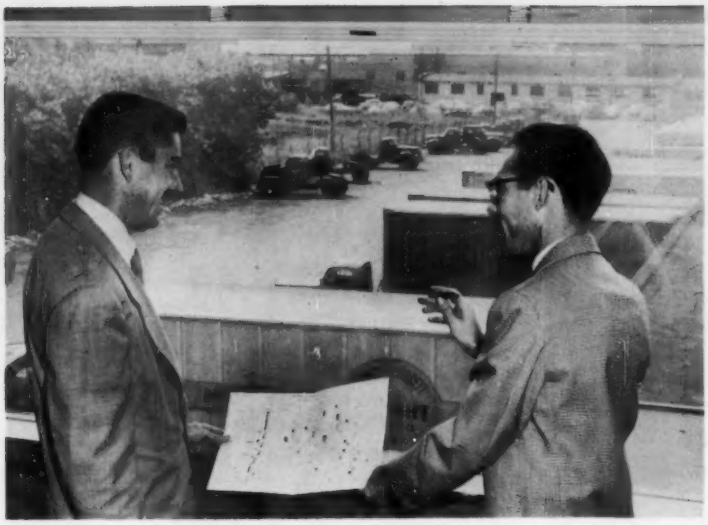
Our management at Cooper-Jarrett, Inc., operating 155 highway tractors and 335 trailers between Kansas City, Chicago, Philadelphia, Trenton, and New York City, is well aware that the trucker who cannot find new ways to beat costs by other means than rate increases is very likely on his way out of business. Accordingly, it has faced the problem on all fronts.

On the operational side, we utilize 80 tractors and 200 trailers to run a "relay" system. Our unusual relay plan to get units back and forth across the eastern half of the country, and a new fleet of GMC diesel-powered tractors equipped with Twin Hydra-Matic transmissions, together have so far been successful in keeping expenses down to a reasonable level.

Just how reasonable might be judged from Cooper-Jarrett's operating ratio which in the trucking industry is the percentage of total expense to gross income. In 1954, it was 89.7%; and for the first quarter of 1955, 87.2%. This gives Messrs. R. E. Cooper, Jr., president, and Guy D. Cooper, executive vice president, some cause for satisfaction. The rest of the industry averages about 98%.

Before getting on to the story about our diesel-Twin Hydra-Matic equipment which we pioneered, some explanation of our relay system, which we also pioneered, is needed.

On our Chicago-New York run, a driver runs a tractor-trailer combination 139 miles from Chicago (near



Guy Cooper (left), executive vice president of Cooper-Jarrett, Inc., and Fred Johnson, operation's manager, inspect a monthly maintenance record at the Chicago terminal. They attribute low maintenance costs to diesels and hydramatic.

Kendallville, Ind.) in about four hours; at which point he gets out and takes over the wheel of another Cooper-Jarrett unit on its way in to Chicago. The driver he replaces takes over the unit that is on its way to New York and drives it to the next driver exchange point, another four hours down the road (near Tiffin, Ohio). Schedules are so arranged that these driver relays across the country are effected with minimum loss of time and have been streamlined to the point where in July the running time was cut from 28 to 26 hours.

In addition to giving our customers exceptionally fast service, the advantages of the relay to us are obvious. Instead of having a truck for each of our 148 drivers, we have only 80. Instead of paying the higher driver wage rates of a sleeper-cab operation, we have regular wage costs. And of our 148 drivers, 96 are home every night, while the remainder are home every other night helping to keep our driver turnover rate one of the lowest in the industry.

In letting 10 different drivers handle a tractor-trailer unit as it makes one round trip of 1700 miles, we recognize that we have run contrary to popular supposition in the industry that a driver assigned permanently to one unit and held responsible for it will give it much better treatment than if he is switched indiscriminately from one to another.

It is a well established fact that some negligent drivers abuse the clutch consistently and also wreak havoc with an engine by lugging it in the wrong gear. These two very bad habits are not expensive to them but make the owner's maintenance costs somewhat staggering.

Cooper-Jarrett has eliminated both headaches by the simple expedient of purchasing highway tractors with the well known GM 4-71 diesel engine pouring its power to the rear axle through a comparatively new device called the Twin Hydra-Matic transmission. This unit consists of an upper and lower unit mounted one over the other, and governed to shift alternately with each other through seven forward speeds and one reverse.

Both units are geared together at the rear, driving a single output shaft connecting with a 3-speed reduction unit provides automatically the gear shifting required under varying conditions throughout three separate ranges—creeper, low, and direct. It also automatically provides expert engine braking on downhill operation.

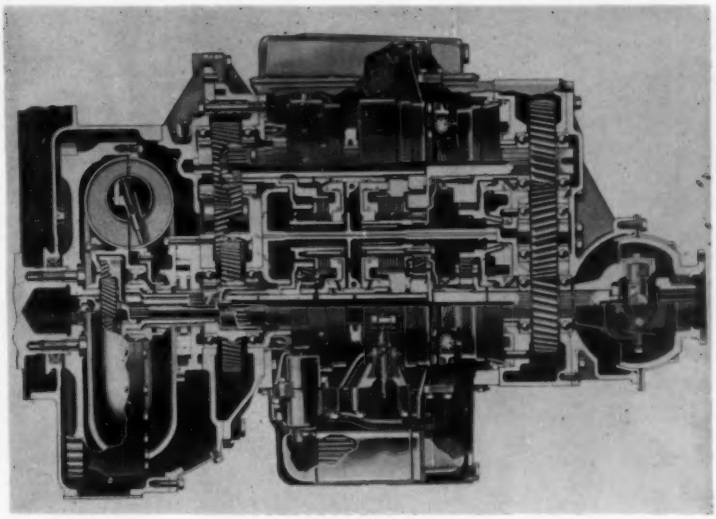
Cooper-Jarrett management must have been eyed askance by some trucking operators for "plunging" on the purchase of a new product, 72 of the GMC diesels with Twin Hydra-Matic, Models DFM660-47, rather than adopt a "wait-see" attitude. We have rather interesting news for the industry after operating them 4,953,398 miles as of June 30.

Cost of operation, including fuel, oil, repairs, and tires, has been 5.3 cents per mile. The first 25 units placed in operation now have more than 100,000 miles on them and some have as high as 140,000.

Added engine life that has been made possible with the Twin Hydra-Matic will let us realize our greatest savings in operating and maintenance costs. Elimination of the human error that allows engines to be lugged by being in the wrong gear, also helps save a great many wasted man hours in our maintenance shops that previously had been used to repair and retune engines that came in from a run loaded and fouled from lugging.

It is interesting to note that we have had only three axle failures in close to five million miles, one of which was driver error and the other two probably driver error. We have replaced one engine which had a camshaft failure. We could have repaired this in the chassis; but since it was the first engine failure, we wished to analyze the engine; therefore a replacement was installed.

While units are in virtually constant operation, run-



Twin hydramatic unit such as used in combination with GM 4-71 diesel for powering part of Cooper-Jarrett trucking fleet. Twin hydramatic units are mounted one above the other and geared to output shaft at left through idler gears.

ning up 4000 miles a week, we have regular preventive maintenance inspections. Injectors are tested every month and if found in good shape, are put back in. Many of our units have gone over 100,000 miles with the original injectors, having had nothing more than an engine tune-up, oil change in engine and transmission, wheel bearings packed, and a few other minor points covered. Due to the engine braking obtainable with the Twin Hydra-Matic, our brake life has doubled.

During the "C" inspection period on these trucks, set for every 100,000 miles, we pulled the hand hole covers on the engines and they were as clean as new on the inside. In testing rings, there was no sign of wear or sludge. Compression still was well within factory specifications of between 440 and 460 psi.

Our maintenance is done at either of two garages, one located at our Chicago terminal and the other at Somerset, Pa. As every truck will get to either of the two garages once in any 24-hour period, and since each truck runs close to the same number of miles each week, we do our maintenance on a calendar basis rather than on exact mileage.

This kind of schedule is easier to coordinate and any given truck can be held in for a preventive maintenance "A", "B", or "C" inspection and repairs, at whichever garage it happens to be on the day such an inspection is due.

The only work we don't do in our garages is accident repair such as body work and some of the diesel engine component parts, blowers and governors, which are sent out for rebuilding.

Another interesting aspect of our introduction of these new units, with a gross combination weight of close to 60,000 lb, was initial driver reaction to them. None of our drivers had had any experience with power steering, and many had never driven with an automatic transmission even in cars. Inasmuch as the new trucks were geared to go only 52.3 mph, they thought the company was foolish to take away the advantages of higher top speeds.

After holding driver meetings to explain operation of the new units and letting them get 5000 miles of driving experience behind them, they were both surprised and happy. Despite the lower top speed, they did not take any longer to make their runs. They could drive at a steadier speed and not have to fly down a hill in order to make it up the next one.

Consequently they were more relaxed and at ease and with considerably less fatigue at the end of their run. This is very important for highway safety. Although we had a 1953 safety record among the best in the country, we improved upon it in 1954.

One of our fears concerning how the units would handle on ice and snow was completely unnecessary. We found that the DMF660s last winter, which was much more severe than the previous one, came through with 500% less damage, financially speaking, than in the most recent comparable winter.

Training our mechanics to service and maintain both the GM diesels and the Twin Hydra-Matic transmission was not difficult. GM has training centers throughout the country capable of giving the necessary training.

This, briefly, is our experience up to 5,000,000 miles with diesel-powered trucks with the Twin Hydra-Matic transmission. Our pioneering in this field has taken some bold and progressive planning on the part of our management, but it has paid good dividends.

There is little doubt in our minds that our operating record under our relay system and the new equipment not only will give Cooper-Jarrett and its customers annual benefits, but will set the pace in the industry for others with similar needs.

Newest of the Greyhounds are the GM Scenicruisers. These are powered by two GM 4-71 diesels mounted in a 140 deg vee, producing 300 hp.

Stop-and-go transit and suburban service requires rugged equipment. Engine speed and power must vary widly and units may idle 75%.

Diesels in GMC Motor Coaches

GM's 2-cycle diesel engine introduced in motor coaches by GMC Truck and Coach Division in 1938 has gained increasing acceptance until today there are over 33,000 in service in the nation, plus several hundred more in Mexico, Cuba, and South America. Since there are 83,000 buses of all types in service in the United States, this represents more than one-third of the total.

The big inducement for conversion of gasoline-powered coaches to diesel power is the 50% or better fuel mileage, together with lower prices for diesel fuel. However, many other features of the GM 2-cycle diesel engine make it ideal for bus operation.

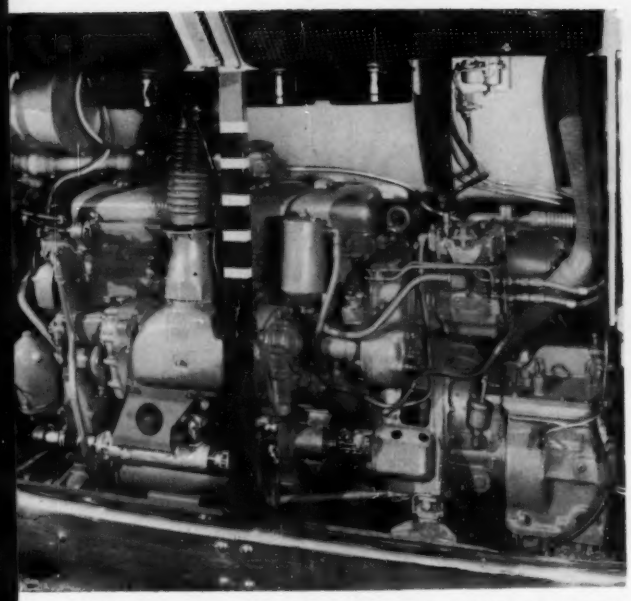
For instance, its design provides a compact unit with a high power-to-weight ratio. It also provides fast acceleration and quick response to varying load conditions such as are found in bus operation.

The dimensions lend themselves to transverse rear mounting and it has been engineered with all accessories mounted on the side facing the mechanic, offering exceptional accessibility for servicing and inspection. Mounted on its own sub-frame, it is quickly removable from the coach on a dolley.

The great majority of diesel power plants installed in coaches are the 6-71 series, used in 45- and 51-passenger transit and suburban models and the 41-passenger intercity coach; 4-71 series engines are installed in the 37-passenger transit model only. Parts interchangeability of 83% on these engines has proven a boon to bus operators. Many bus operators have mixed fleets of 4- and 6-cyl engines. This interchangeability enables them to operate coaches from 32- to 53-passenger capacity with minimum parts inventory.

Since the "71's" basic design has been unchanged since its introduction, all refinements and improvements can be applied on earlier models. This has enabled bus operators to modernize older engines and standardize on shop procedure. Continued research and component improvement has increased engine life to such an extent that records are broken nearly every year.

You can get some idea of the performance of GM diesels in bus operation from the experience of Indianapolis Transit System, Inc., a small suburban operation which began conversion to these engines in 1950. Six units are in service today. During the 1,681,805 miles they had operated up to February 1, 1955, they had averaged 5.5 miles per gal of fuel.



Typical rear-end engine mounting in transit coach. All accessory equipment is mounted on near side of the engine for ease of accessibility.

Power for the intercity model is the GM 6-71 diesel, rated 211 hp at 2000 rpm. Nearly 9000 GM over-the-road coaches are now in service.

The first two diesels purchased by this company have broken all records for long life in bus operation. One unit by February 1 had run 557,981 miles; and a second unit, 448,793 miles, with neither one having a head lifted or a pan dropped.

This is a sensational record, even for bus operation. The diesels' performance in this case has been helped by the flat terrain in Indiana, operation of the coaches by the same drivers every day, and open-country running. Attention to factory-recommended maintenance procedures has also been a contributory factor.

This operator also ran his diesel fleet without a single road failure in 1954, enabling him to offer more dependable service to his patrons. GM diesel power, in conjunction with the Allison hydraulic vee-drive, has resulted in safer bus operation and a more comfortable ride by elimination of hand gear shifting and the jerks and jolts of mechanical transmissions.

Diesel power economy has been a boon to financially pressed transportation companies, enabling them to regain, in many instances, their earning position. Where streetcars were retired, the bulk were replaced by GM-powered coaches. Cities which have recently retired all their streetcars or are in process of doing so, are Minneapolis and St. Paul, Los Angeles, Detroit, Cleveland, Cincinnati, and Denver.

GM diesel power has done an even greater job for the intercity bus operators where mileage is naturally higher than in city systems.

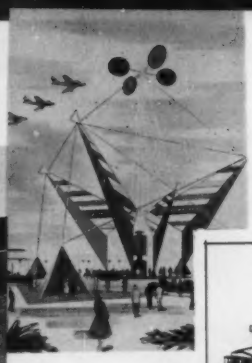
The Greyhound Corporation has practically standardized on GM diesel equipment. It reported not long ago, that upwards of 800 of its earlier models had been operated over one million miles with original engines. Some earlier units, it reports, are even approaching the 1,500,000-mile mark.

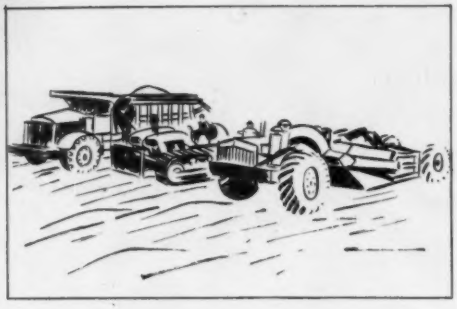
The National Trailways System, through its various carriers, has been a large user of GM equipment. Large numbers of small independent carriers have also converted to diesel power. There are about 9000 GM diesels in intercity service today.

It is no idle claim to state that at present, fare structures, the intercity bus industry would be largely bankrupt today without GM diesel power, since the profit margins are so slim.

It was stated earlier that engineering projects are underway continually to lengthen the performance of GM diesels. Bearing this out—in city operation, 75,000 miles between ring jobs and 150,000 miles before overhaul were considered very satisfactory. Today the mileage has been doubled, with some transit companies running their equipment over 200,000 miles before changing rings and sleeves. A 300,000-mile engine life is becoming standard in transit operation, while intercity operators are running their diesels 400,000 miles or more before rebuilding.

Engines built in 1940 are still in operation today. In fact, though engines have been built for the bus industry for over 17 years now, there is still no report of an engine wearing out to a point where it could not be economically repaired and put back into service.





Euclid Division

EUCLID Division of General Motors has made its name from, and designed its products for, man's need to change the face of the earth. Earthmoving and its companion, oremoving, are assuming ever greater importance. Earthmoving is an inevitable process tied in with the badly lagging highway construction program, with the need for dams for water conservation, power sources and flood control, and various large construction programs. Federal legislation in these fields will soon spur even greater activity.

In the field of mining, the expanding economy requires ever increasing flow of the raw materials. Improved equipment that facilitates faster and cheaper flow of iron ore, copper, coal, asbestos, gypsum, and more recently uranium, reflects in the available supply and also the cost of the refined materials.

The Euclid Road Machinery Company, even before becoming a division of GM in September 1953, devoted its whole effort to supplying heavy-duty off-highway machinery for economical transportation of bulk materials. Since joining the GM fold, Euclid activities are perhaps most notable for the continuing parade of new types and capacities of earthmoving equipment that are appearing in rapid succession.

Heavy-duty dump trucks were one of the first products to establish the name of Euclid. Its first rear-dumps went into service on the Mesabi Iron Range in 1937. The first twin-power machine, a 34-ton rear-dump, went into service nearly 10 years ago in response to demands of the industry for more power and greater earthmoving ability. Since that time, the twin-power principle has been applied to a line of dump trucks, scrapers, and tractors.

Euclid will take the occasion of the Powerama to unveil new additions to its line of products. One of these will be the C-6 crawler; another a new S-12 overhung engine-type, rubber-tired scraper.

The C-6 crawler is the second of a projected line of tractors developed by Euclid to meet earthmoving, open-pit mining, logging, and industrial applications. It joins the big 388-hp twin-engine TC-12 crawler introduced last September. In fact, it is a half-section of its big brother. The TC-12 has two 6-71 Detroit Diesel engines, whereas the C-6 uses a single 194-hp, 6-71 engine.

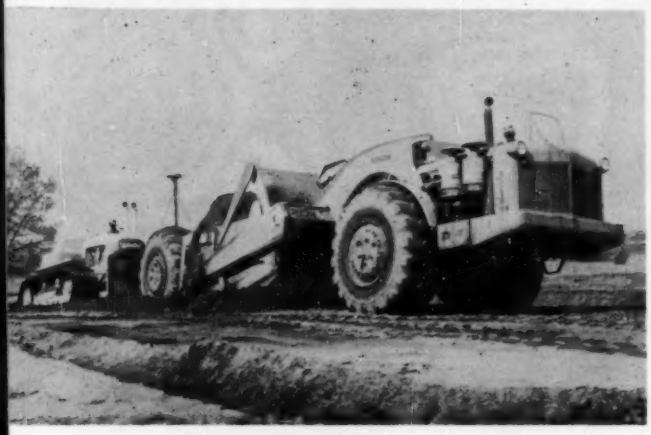
Contributing to maneuverability for dozing and scraper push-loading, engine power is transmitted to the tracks through an Allison torque converter and semi-automatic transmission and Euclid's planetary final-drive gearing. All shifting is done under full power without loss of motion, and a shift into reverse is possible with the tractor still going forward.

Styling is the same as on the TC-12. Features including controls, automatic track-tensioning, hinged front engine cover, and rear-mounted swing-down radiator, are the same as on the TC-12. There are three speeds forward and three in reverse with a top speed of 8.3 mph. The tractor weighs 34,000 lb without attachments or mounted equipment.

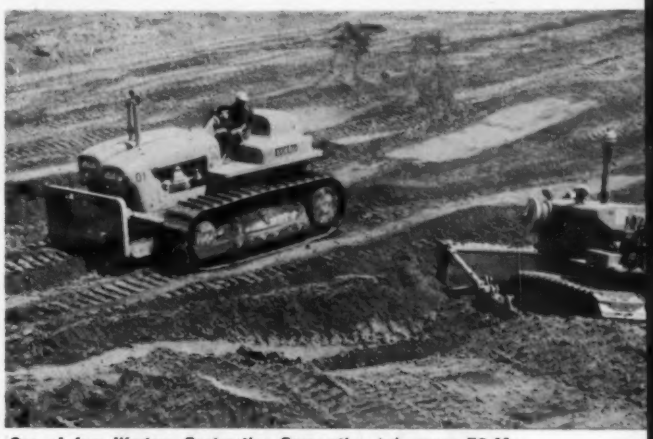
The new S-12 scraper is powered by a 218-hp engine, has a standard transmission with five forward and one reverse speed with hydraulic steering and scraper controls. It has the Euclid planetary final drive and a no-spin differential. The scraper bowl uses 4-section offset cutting edges that are identical, reversible, and interchangeable.

In all, 31 Euclid machines of five earthmoving types will be displayed at the Powerama. These are rear-dumps, bottom dumps, self-propelled scrapers, crawlers, and a loader. Rear-dumps will be of 10-, 15-, 22-, 34-, and 50-ton capacities. Scrapers will include the 15.5-yd 3-axle scraper and the S-7, S-12, S-18, and TS-18. Then there is the loader and the 17-yd bottom dumper.

Euclid has moved far and fast in the production of a diversified line of earthmoving machines. In addition to the big machines to meet today's demand for greater production, most using the twin-powered principle, the line is being broadened so that machines can be matched to each other, to the loading equipment, and to the specific job.



A TC-12 crawler tractor and a TS-18 scraper, both twin-power units, working together as a powerful earthmoving combination.



One of four Western Contracting Corporation twin-power TC-12s, rigged for pushing, on the 7 million-yd Indiana Turnpike job.

Twin-Power Earthmovers Move Today's High Yardage Faster and Easier

EUCLID pioneered in twin-power machines when it built the first such unit, a 34-ton rear-dump, at about the close of World War II. After trying other methods of providing the power necessary for the ever bigger machines demanded by the earthmoving industry, this was decided to be the best approach. Paired, proven engines were used, with each driving a separate axle through a torque converter and semi-automatic transmission.

Developments since that time, culminating in the design of the big twin-powered TC-12 crawler, have justified the original decision. It has had an effect on both the cost of earthmoving equipment and on operation. Many factors enter into this.

First, twin-power made possible utilization of high-production volume and thus lower-cost engines used in other smaller sized machines. The same holds true for other drive-line components and assemblies. It follows that this results in a similarly favorable parts supply and parts cost position.

Availability of a drive-line with matched and proven components eliminates need for developing a new power train for each new piece of equipment. This is a big cost factor. Interchangeability is also made possible. Thus, the single engine with a single converter and transmission as used in the C-6 crawler is just half the power and power train as used in the big TC-12. Similarly, final drive gearing in these crawlers is the same job-proven Euclid planetary used in the off-highway 50-ton trucks and the 25-yd bottom-dump hauler.

Euclid's experience with twin-power units includes the 34-ton rear-dump, the 50-tonner, a twin-powered bottom-dump, and a 3-axle scraper. It is also being used to good advantage in the new TC-12 crawler and a new 2-axle overhung-engine scraper having an 18-yd struck capacity.

A major reason for the success of the twin-power idea is the hydraulic torque converter. It permits the use of two engines without need for synchronization or use of complicated mechanical linkages and power dividers. The characteristics of automatically adjusting the torque multiplication ratio to meet load conditions, properly balances the power delivered by the power trains.

Torque converter drive has also proved to be advantageous in the single-engine units. This is particularly true when operation is over variable grades. The converter's ability to adjust to grades, roads, and loads, is a definite factor in obtaining higher production.

Driver acceptance and ease of operation are additional factors that have increased popularity of the hydraulically driven unit. Approximately 20% of all Euclids built in 1952 were converter-equipped, and this has risen to 50% at the present time.

Thirty of these twin-power 50-ton Euclids are used by Western Contracting Corporation on the huge Fort Randall Dam project.

TS-18 scraper on Indiana Turnpike job. Power on both axles helps loading and speeds 21-yd load to fill area.

Big Machines for Big Jobs Cut Costs

Matched teams of high-capacity machines are boosting daily production while reducing unit costs.

Six 50-ton twin-power Euclids are loaded with 7-yd dragline on Western Contracting Corp. Indiana Turnpike job.

WITH the completion of the Indiana Turnpike and the Ohio Turnpike, travelers will be able to go from Chicago to New York via turnpike without one traffic light or intersecting highway!

Motorists will whiz along with never a thought of the yards of dirt moved, the construction problems involved, or cost items. That's not their business. But it is the business of the contractors who bid on the job. They had to figure each step of the job, the yardage to be moved; the shaping, grading, drainage, stabilization and compaction, laying of base and sub-courses, paving, and all the other jobs involved in modern roadbuilding.

The amount of work to be done is the same for all bidders; to be low bidder you have to figure how to do the job most economically. Experience and the planning of the work are big factors and so is selection of the machinery to be used. It goes beyond simple selection of the type and capacity of equipment. For example, length of haul would determine whether scrapers or dump trucks would be the most economic. But it would also be influenced by maneuverability, speed, ease of control, etc.—affecting turn-around time and production.

Western Contracting Corporation in undertaking high-yardage jobs has pinned its faith on big equipment. It also is a proponent of the twin-power principle. It put 30 50-ton Euclid rear-dumps to work at Fort Randal Dam a few years ago, loading them with 11-yd Marion 191M shovels.

Twelve of these units are now operating at Gavins Point Dam, a 7 million-yd job; 12 others at Oahe Dam, a 16 million-yd job; and six are on the Indiana Turnpike where 7 million yards are to be moved. On this job, the twin-powered 18-yd TS-18 overhung-engine scrapers were teamed with the TC-12 crawler tractors.

In bidding on approximately 28 miles of the turnpike, figures quoted were based on the premise that this powerful combination of units could substantially reduce earthmoving costs. There are two separate spreads of four TS-18s and two TC-12s each. Production recently surpassed 32,000 yd for a 20-hr day on haul cycles averaging a mile.

There are also two additional TS-18s on the job. The material handled is sandy, weighing 3300 to 3400 lb per cu yd, and is exceedingly difficult to load. Western also has the six 50-ton rear-dumps on the job, loaded with an 8-yd dragline.

Western's operation typifies modern trends in selection of equipment for big earthmoving and construction projects. Big machines with high horsepower, good flotation and maneuverability, high capacity, versatility, and ease of operation, are giving us modern highways, dams for power, conservation and flood control, airports, and similar projects, for the lowest possible unit costs.

To appreciate the full impact, consider this. The Bureau of Public Roads estimated that road excavation costs for the proposed 100 billion dollar Federal highway program would cost 90 billion dollars more if the equipment and methods of 1923 were employed!

About 1400 Euclids replaced rail system to boost Minnesota Iron Range production.

Hauling ore at the Jackpile Uranium mine after 120-ft overburden was stripped off.

Two 10-ton Euclids replaced five highway trucks, cutting costs for Memphis Stone and Gravel Co.

And in Mining Operations, Too

ECONOMICAL open-pit mining is essentially a problem in materials handling. Bulk is greatest at this phase of the cycle from ore to finished product. Off-highway dump trucks with their flexibility of operation and independence of trackage have played a pioneering role in cutting the cost of moving earth, rock, coal, and ore of many kinds. Today, they are practically standard.

Euclid's off-highway rear-dump hauling units pioneered this operation. On the Mesabi Iron Range where Euclid rear-dumps went into service in 1937, the flexible use of trucks in place of rail haulage was responsible for a step-up in the speed of mining operations. Production rose more than 50% in tons handled per man hour.

Today, such dump trucks are active in large-scale mining of iron ore, asbestos, and gypsum. Total operating costs of moving overburden, rock and ore, exclusive of the cost of equipment, are unofficially reported by various companies in a range of from 4 cents to 12 cents per ton. At a Canadian asbestos mine, engineers originally estimated that replacing a rail system with Eucs might reduce transportation costs by as much as 50% and loading costs by as much as 40%. Experience proved that these estimated savings were conservative.

Such economical movement of materials, combined with the flexibility of operation, has made it possible to lengthen hauls; go to deeper depths to reach coal, ore, and other minerals; work steeper grades; and reach otherwise inaccessible ore bodies. This adds up to an increase of available minerals without a substantial increase in their cost.

Recently the economy of off-highway hauling units was extended to uranium mining in the United States, Canada, the Belgian Congo, and Australia. Illustrating the need for economical hauling, overburden extending to a depth of 350 ft to 400 ft is being removed to reach uranium deposits. This is being done by Gunar Mines Ltd. on Lake Athabasca in Saskatchewan, Canada.

Near Grants, New Mexico, Anaconda Copper Mining Company's big Jackpile ore body is being uncovered by the removal of more than a million yards of rock overburden extending to a depth of up to 120 ft. Anaconda uses its Euclids to haul the ore and has assigned the job of overburden removal to the fleet of the Isbell Construction Company.

Isbell, with years of experience in stripping operations on various mining jobs, is among many owners who have stepped up from 15-ton to 22-ton Euclids. Where direct comparisons were possible, company officials have stated that the larger units have proven to be 12% to 20% more efficient.

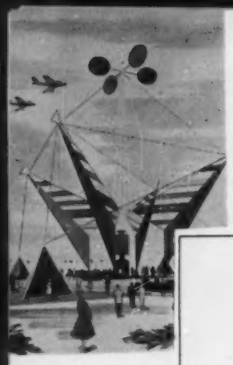
This follows the general pattern of increased efficiency as sizes increase. Of course, the larger dumps require more exacting matching to the job and with adequate loading equipment. For example, field experience has indicated that the 50-ton Euclid, when balanced with shovels in the 8- to 11-yd class, is capable of out-producing the 34-ton truck as much as 45%.

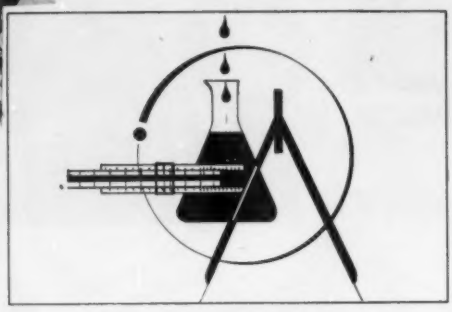
Where jobs are small, the smaller capacity equipment is of course best suited. Even in this case, the use of Allison's Torqmatic drive is increasing the production of these dumps, compared with mechanical drive units, by anywhere from 5% to 15%.

Wherever off-highway operation is required, the power and stamina of the smaller Euclid dump trucks are paying off. At the Memphis Stone and Gravel Company, two 10-ton units replaced five highway-type trucks on a quarter-mile haul. In four years, repairs totaled $157.

In Arkansas, Freshour Brothers found that two units similarly replaced five highway trucks in feeding a portable crushing plant. They also greatly reduced the cost of setting up the plant at various locations. G. P. Freshour points out that with the Eucs, they are able to put in a 10% grade out of the pit, build a steep ramp to the crusher, and easily keep the plant running at 140 ton per hr. And no abuse of equipment was involved.

Big job or small job, rugged and powerful dump trucks are designed to take the punishment of heavy-duty, day-in and day-out off-highway hauling. The cost reductions made possible in this type of materials handling by modern equipment is playing a spectacular though often unheralded behind-the-scene role in our national economy.





Research Laboratories Division

Working with and for the other GM divisions, Research Laboratories Division applied science and technology, solving today's problems and exploring as well as charting courses for the future.

NORTH of Detroit, the huge General Motors Technical Center is nearing completion. The 320-acre site will embrace 25 buildings ranging from gate houses to laboratories. Architecturally as modern as tomorrow, and as impressive and functional as it is, it represents only the physical side of the Technical Center.

More important are the people that will use this new workshop. More than 3500 engineers, researchers, stylists, designers, mechanics, machinists, and other specialists are involved. Overall mission of the specialized personnel is to explore the future.

A shortrange objective is the improvement of today's techniques, methods, and products. The longrange view scans new horizons and charts new courses. The general purpose is to use science and technology to keep GM in business years and years from now.

Broadly speaking, central staff operations at the Technical Center are organized into four groups: Research Laboratories Division, Engineering Staff, Process Development Section, and the Styling Section.

Research Laboratories Division concentrates on longrange projects and studies in the mechanical arts and basic sciences. Engineering staff operates service facilities for various GM divisions and specializes on development work in the field of engines and other products.

The Process Development Section makes engineering studies and undertakes projects aimed at improving manufacturing techniques and processes. Their goal is greater plant efficiency with higher quality, lower cost products. The Styling Section serves as a central staff by maintaining separate groups for each of GM's automotive divisions—including GMC Truck and Coach.

GM's whole participation in the diesel industry was born in the GM Research Laboratories. Charles F. Kettering, former head of the Research Laboratories Division, was attending physician. The mother was "Big Bertha". The pre-natal period started in 1928 when Mr. Kettering negotiated with the Winton Engine Company for two diesel engines for his new yacht, OLIVE K.

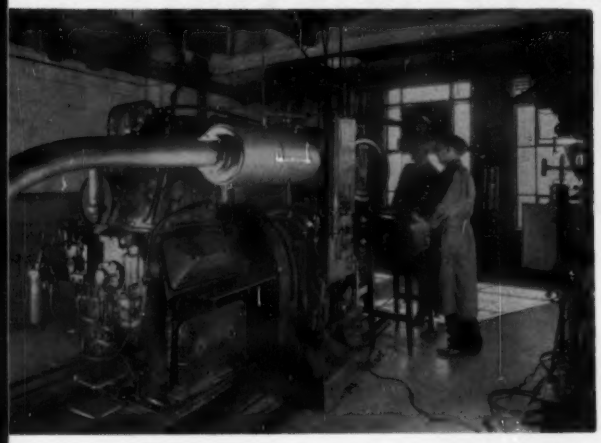
Dissatisfaction with their internal functioning led Mr. Kettering to prescribe explorative tests on which to base remedial action. The guinea pig was "Big Bertha", one cylinder of an 8-cyl, 8-in by 10-in Winton engine rated 37.5 hp. She was given a series of injections with a new unit injector developed by Research Laboratories. Bertha began to pick up.

Bertha's pulse rate was stepped up from 4-cycle to 2-cycle operation. She was now more powerful for her size. They tried her out on a 100-hour endurance run and she came through with flying colors—80 bhp at 720 rpm or double the output before conversion from 4-cycle operation. Big Bertha had produced and GM was really in the diesel business.

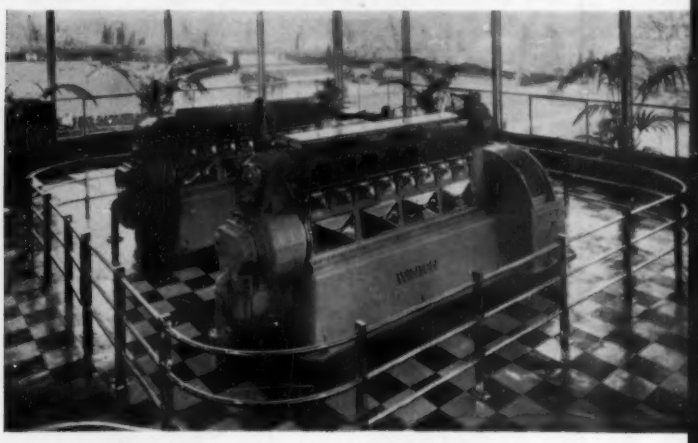
GM Research not only developed the first of the unit injector designs. but also perfected the manufacturing techniques and built them for a period. They did the same in the case of the 3-lobed, aluminum scavenging air blowers and for several years supplied the blowers for all production GM diesels.

In 1933, an ambitious project was tackled. Two diesels were to be built which, driving generators, would light the GM Exhibits Building at the Chicago World Fair. Two 8-cyl, 600-hp engines based on the Research design were constructed on a cooperative basis at Winton (purchased by GM in 1930 and later to become the Cleveland Diesel Engine Division).

The engines created a great deal of interest. They were one-fifth the weight and one-fourth the size of most contemporary engines of equivalent horsepower. Out of GM Research had come a lightweight, compact, high-speed diesel—the goal of many years—that opened up hundreds of new applications for diesel power.



Research started with "Big Bertha", a one-cyl, 4-cycle test engine in 1931. Results with conversion to 2-cycle operation and the new unit injector sparked the line of later GM diesel developments.



First 8-cyl, 2-cycle Winton (now Cleveland Diesel) engines with all features developed by GM Research Laboratories. The 600-hp units powered GM Building at 1933 Century of Progress exposition.

Incorporated in these engines were many components, the products of GM Research Laboratories' development work. Investigation in such fields as piston design, piston rings, valve gear, bearings, and lubrication, paid off in these and subsequent engines.

As early as 1930, GM Research Laboratories had undertaken investigation of a diesel truck engine. A 4-in by 5-in, 3-cyl diesel was designed and built for installation in a 1½-ton Chevrolet truck. The program was sidetracked for concentration on the larger engine, but was revived later in the form of a 3-cyl, 4½-in by 5-in version for the same general purpose.

The encouraging results and the foreseeable tremendous market for a small lightweight high-speed diesel brought about formation of a group of development engineers to design a production engine. The result was the "71" series engines. Detroit Diesel Engine Division was created in 1938 to produce them.

GM Research continued its diesel development activities in cooperation with engine-building divisions. The so-called "pancake" engine of World War II was one of its designs. This became the prototype of the 16-338 vertical-shaft engines built by Cleveland Diesel for the Navy's fastest submarines.

Basic research developments are only part of the service rendered to the GM divisions. The facilities for physical testing and the elaborate instrumentation available have been used in the development of parts and components. Development and evaluation of new manufacturing techniques and processes—balancing, machining, grinding, plating, dipping, heat treatment, casting techniques, to name a few—are under continuous study.

And the scope of effort is not confined to tomorrow's diesel engines but to detailed evaluation and development of newer forms of power. Gas turbines, free-piston engines, jet and turbo-jet engines all get attention. The scope of interest of the GM Technical Center is as broad as the future. But since this projection into the future started some time back, GM customers have reaped benefits, are reaping benefits today, and can look forward to continuing progress in the future.

Engineering Staff Administration Building at GM Technical Center is as "advanced" as the Center's scope of interest.

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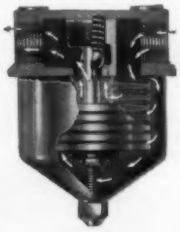
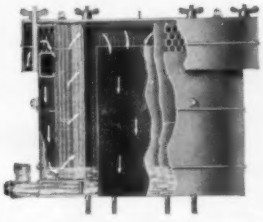
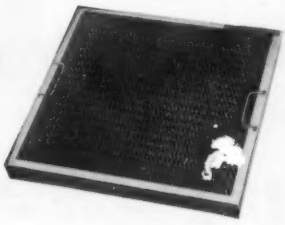


FUEL AND LUBE FILTERS

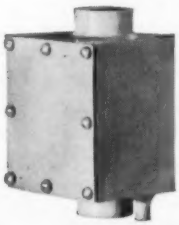


OIL BATH AIR FILTERS

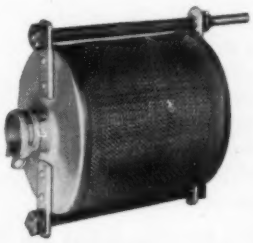
BREATHER FILTERS



PANEL FILTERS



OIL SEPARATORS



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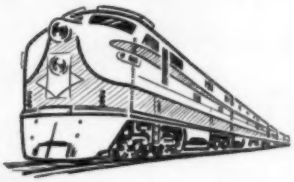
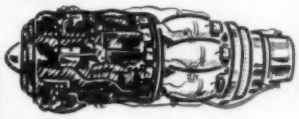


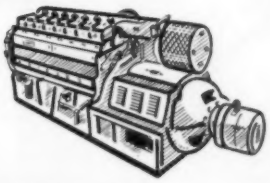
TRUCKS

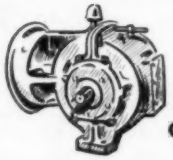
JET ENGINES



AUTO AIR CONDITIONERS

DIESEL ENGINES





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Lake Shore Drive next to Soldier Field
Chicago — Aug. 31 through Sept. 25

Railroad history may start a new chapter when the Electro-Motive Division presents General Motors' concept of the train that can put the railroads in a strong new competitive position in the passenger field.

Plan *now* to see how revolutionary new design and Air Suspension springing will put new scheduled speed, a new concept of comfort and striking economies behind the railroads' bid for travel business.

See, too, the revolutionary Frigifrater—Mobile Power Cars and Trailer—a real oil drilling rig in action—the rebirth of a locomotive—dozens of fascinating exhibits, all part of the tremendous spectacle of the Powerama.

This celebration of General Motors' 100 Millionth Diesel Horsepower will be literally a World's Fair of Power. Acres of absorbing demonstrations will give "sidewalk superintendents" ringside seats as mechanical monsters show their abilities.

You'll be intrigued to see "Gertie the goldfish" swim safely past 25,000 volts of electricity in a display of insulating power of new plastics . . . how your voice can start a 1,000 kw. Diesel-Electric generating set . . . and the great outdoor stage show—with music, dancers and spectacular acts.

Start making arrangements now to see the GM Powerama.

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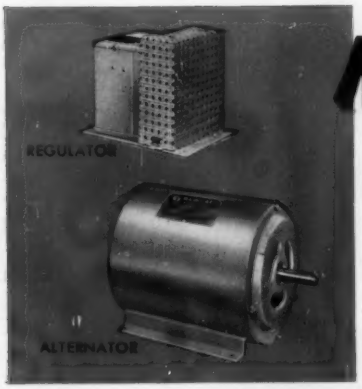

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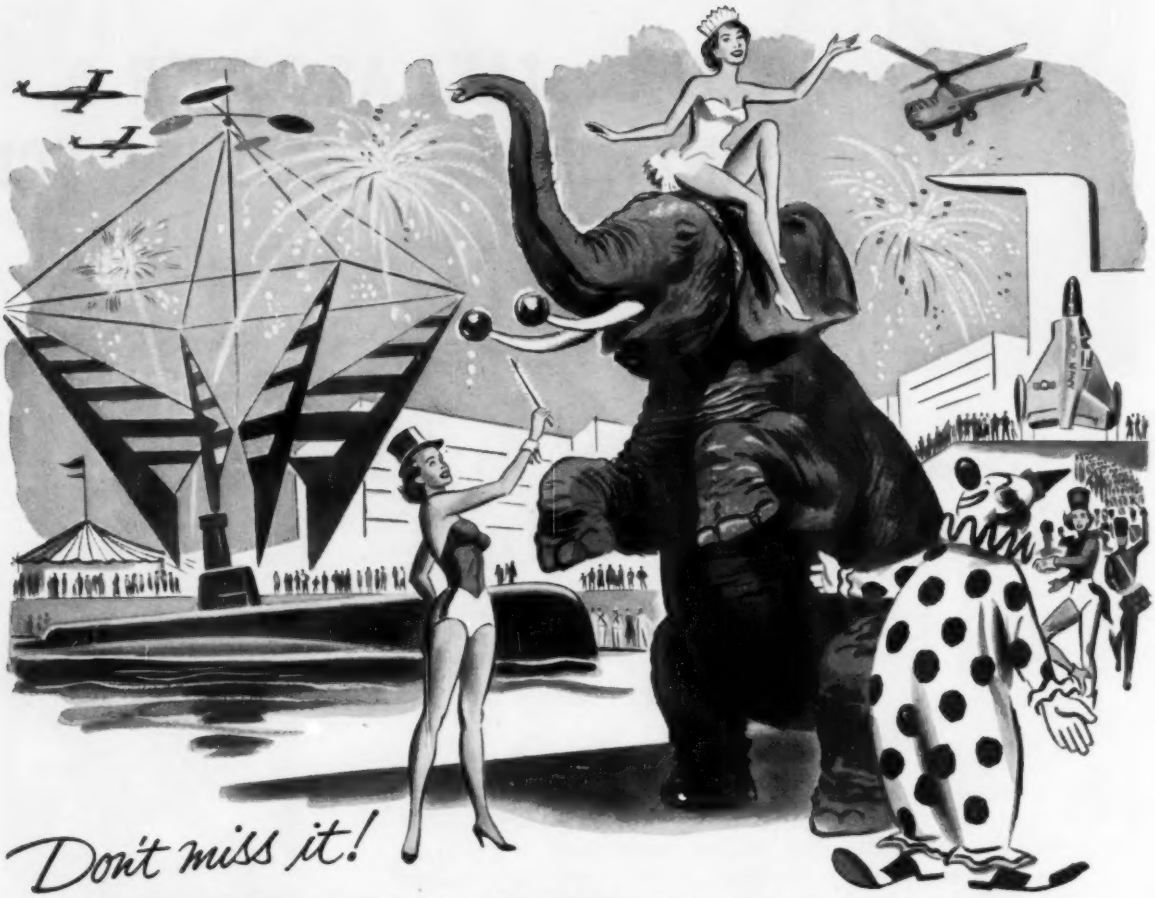
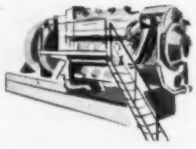


THE GENERAL MOTORS POWERAMA

THE WORLD'S FAIR OF POWER—LAKE SHORE SOUTH, CHICAGO—AUGUST 31 THROUGH SEPTEMBER 25



HERE'S YOUR CHANCE to see for yourself the great General Motors turbocharged 2-cycle, 16-cylinder, 4500-hp. engine—and to inspect the latest GM Diesel developments.

It's the General Motors Powerama created to celebrate the building of GM's 100,000,000th Diesel horsepower—staged at a fabulous wonderland on Chicago's Lake Front.

Here you'll inspect a GM Diesel-powered submarine, look over the largest GM Diesel-powered tug on the Great Lakes.

And here you'll see a brand-new idea in the world of entertainment—the first Technological Circus—"More Power to You"—an amazing combination of circus thrills—eye-opening vehicular skills and dazzling entertainment.

And best of all, *it's all free.* So bring the family—they'll enjoy it just as much as you.

POWERAMA FEATURES

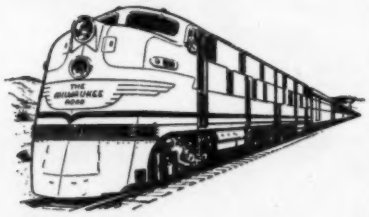
- Stage Show—music, dancers, fun for all
- World's newest lightweight train
- Diesel-powered boats, tractors, road-building machines
- Oil-drilling rigs in action
- Mammoth trucks
- Scores of Diesel-powered units at work

CLEVELAND DIESEL GM

CLEVELAND DIESEL ENGINE DIVISION

General Motors • Cleveland 11, Ohio

Castings for *Diesel Power*



DIESEL power requires castings that are at the same time intricate, massive, and accurate. Because *Mocasco* Gray Iron Castings fit these and other *GM* specifications, they find places in *Electro-Motive* Diesel Engines and *Allison* Transmissions and Converter Drives on display at General Motors' great Powerama at Chicago.

We are currently producing over 40 types of castings for diesel engines as well as pressure-resistant castings for converters and transmissions for heavy equipment.

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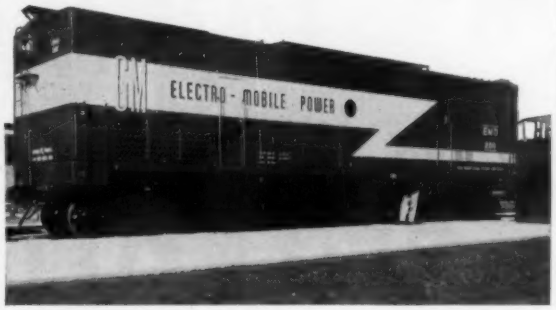
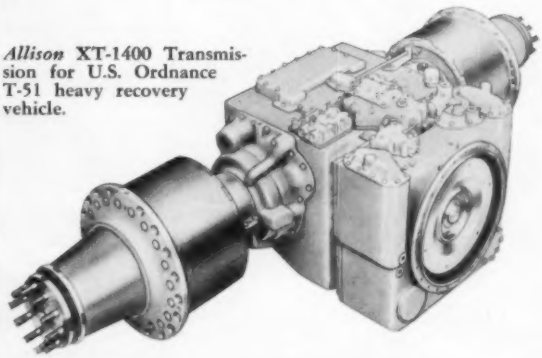


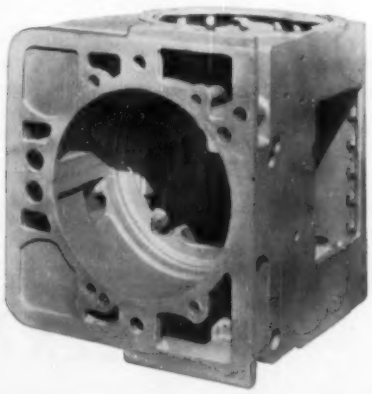
Electro-Mobile Rail Car, Diesel-powered electric generating unit.

Diesel cylinder liner, piston, and head castings (cross section) of *Mocasco* Iron for diesel engines.

Allison XT-1400 Transmission for U.S. Ordnance T-51 heavy recovery vehicle.



Mocasco Iron housing for the Allison XT-1400 Transmission.



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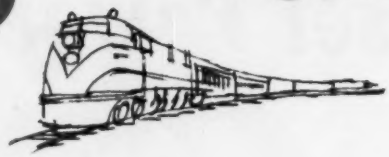

Here at Central Foundry Division we are casting parts from malleable iron, grey iron and Armasteel by the green sand or shell casting processes, for Diesel engines, gasoline engines, transmissions, etc., for virtually every form of power-producing unit. In this age of constantly increasing power demands, we're proud of the part we are playing in powering America.

51

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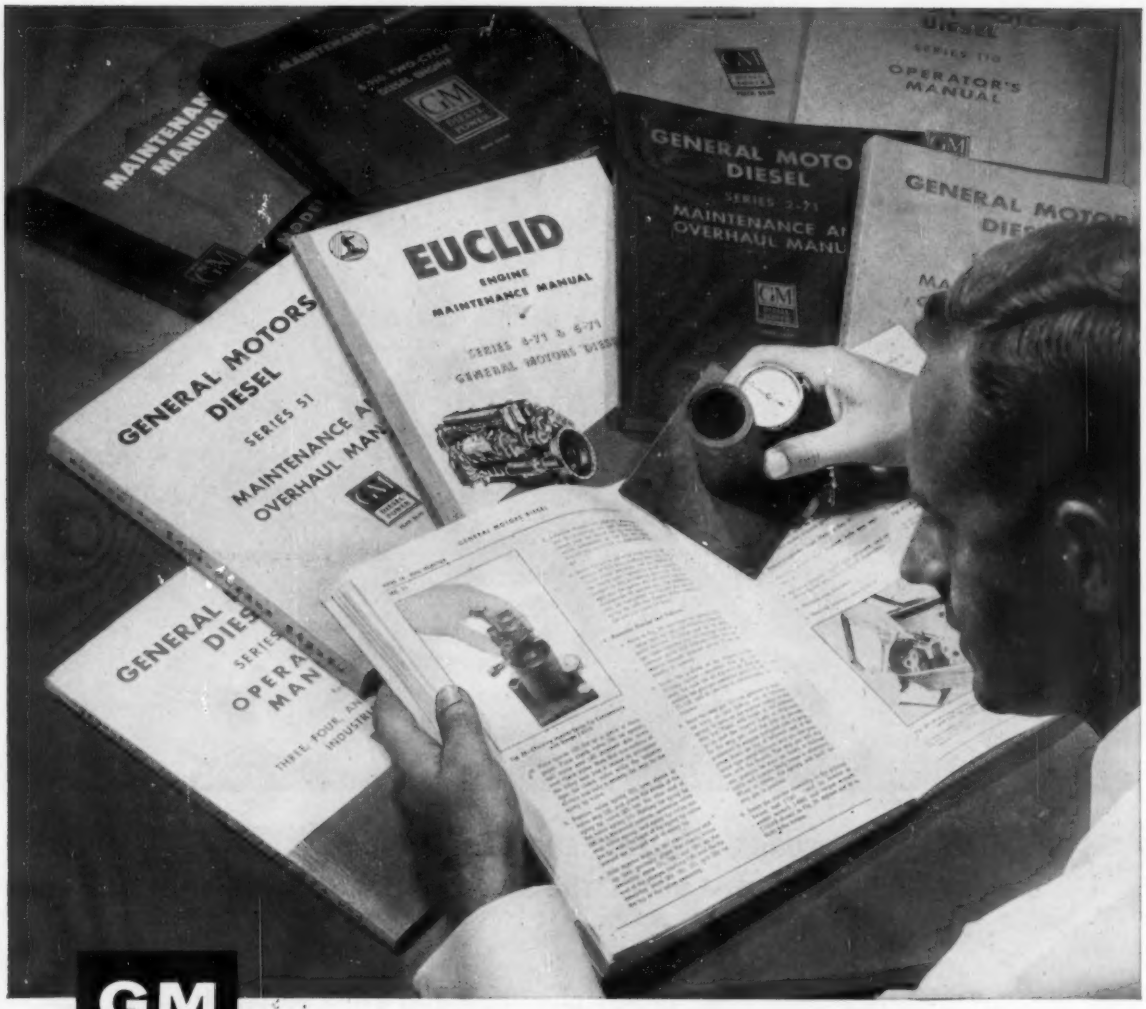

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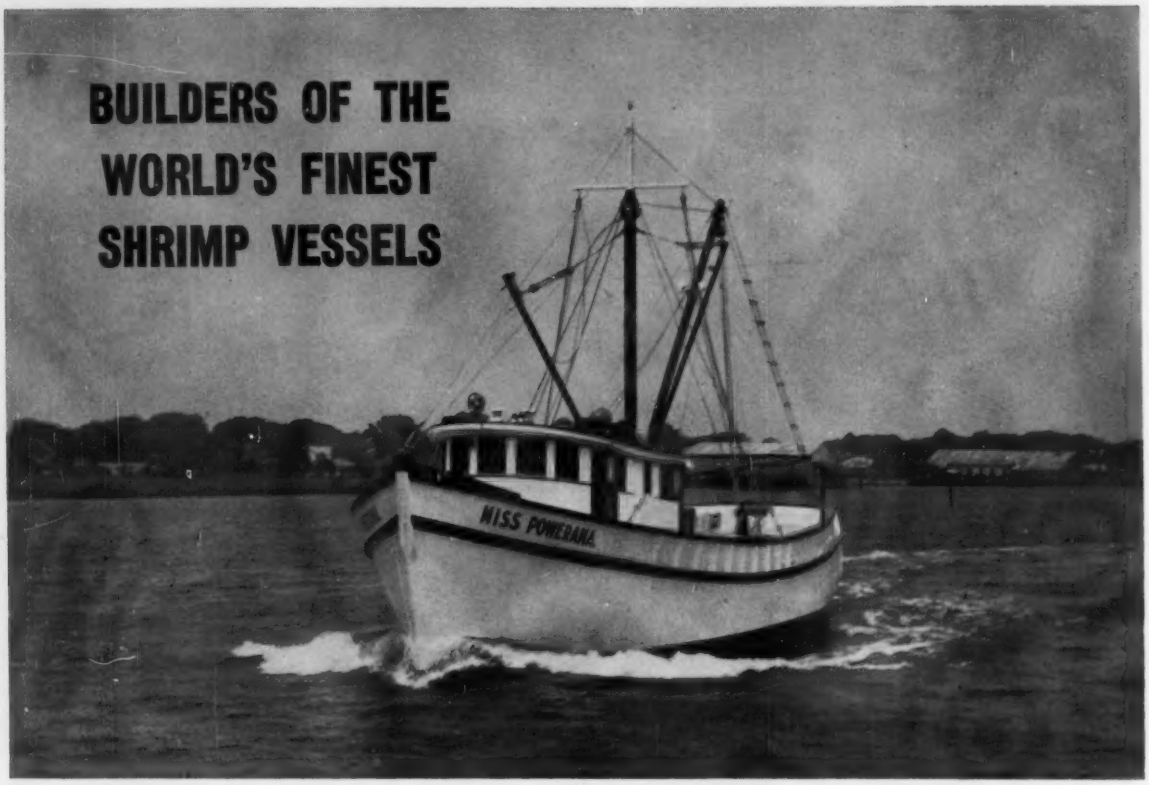

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On the Lake Front in Chicago

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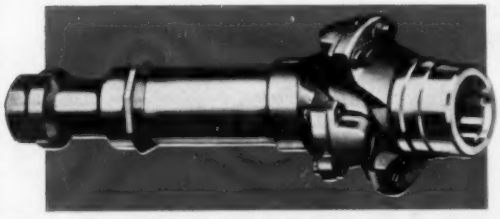

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Lake Shore—South, Chicago · August 31 through September 25

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It's the General Motors Powerama created to celebrate the building of GM's 100,000,000th Diesel horsepower – staged at a fabulous wonderland on Chicago's Lake Front.

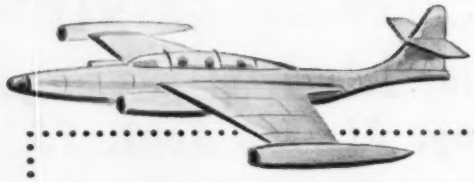
Here you'll see Allison TORQMATIC DRIVES smoothly transmitting Diesel engine power – see why these proved drives make any engine run better, more efficiently.

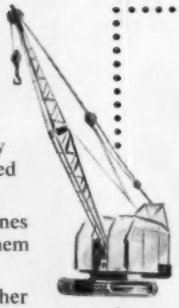
You'll see a wide range of TORQMATIC-equipped machines in action, watch them speed through their paces, see them change the face of the earth.

You'll watch TORQMATIC-equipped Army tanks and other military vehicles performing breath-taking maneuvers – see twin-jet Scorpions and a sensational VTO interceptor, both powered by Allison aircraft engines.

And here you'll see a brand-new idea in the world of entertainment—the first Technological Circus—"More Power to You"—an amazing combination of circus thrills—vehicular skills and big-time entertainment.

And best of all, *it's all free*. So bring the family – they'll enjoy it just as much as you.





POWERAMA FEATURES

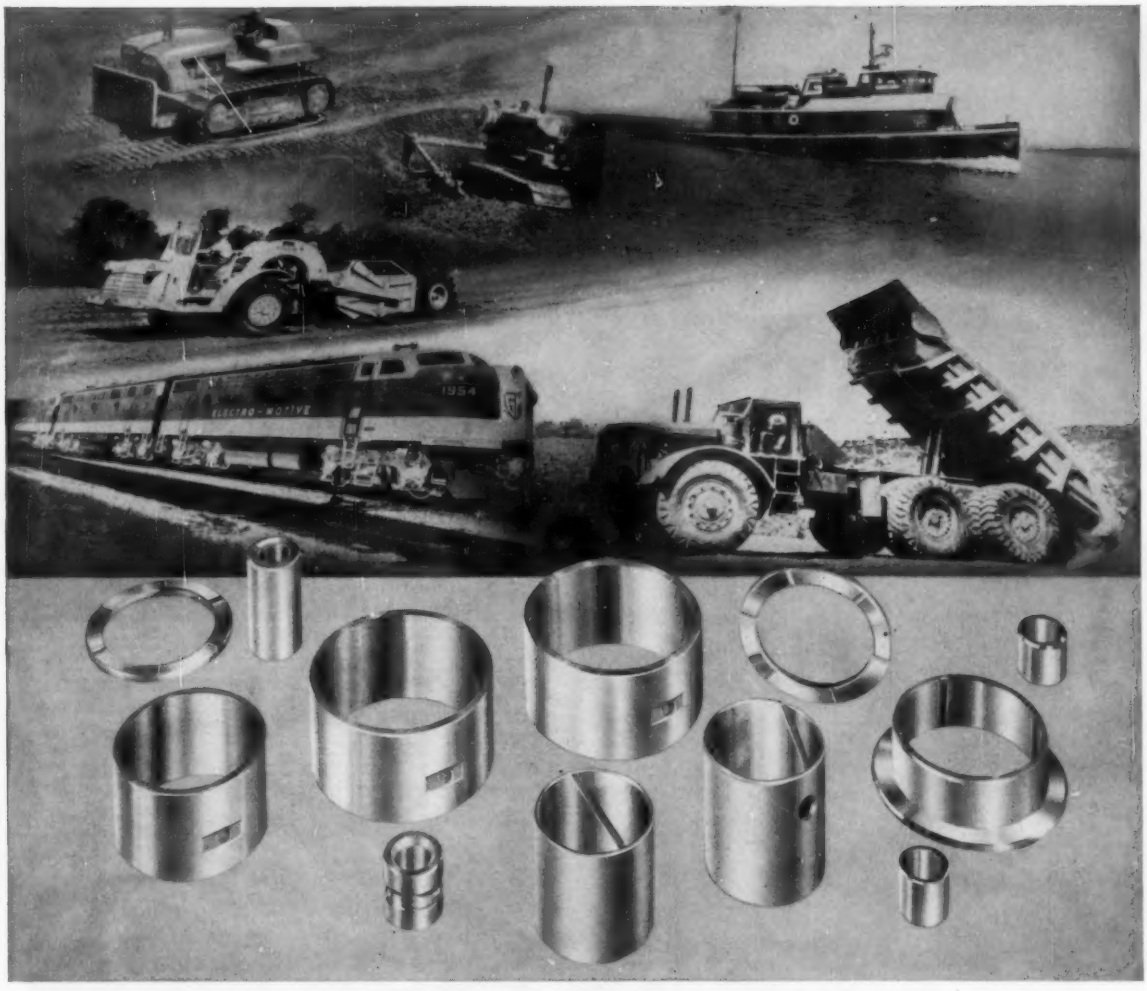
- ★ *Stage show—music, dancers, fun for all*
- ★ *World's newest lightweight train*
- ★ *Diesel-powered boats, tractors, road-building machines*
- ★ *Oil-drilling rigs in action*
- ★ *Mammoth trucks*
- ★ *Scores of Diesel-powered units at work*

GM TORQMATIC

Allison

TORQMATIC DRIVES

Allison Division of General Motors, Indianapolis, Indiana



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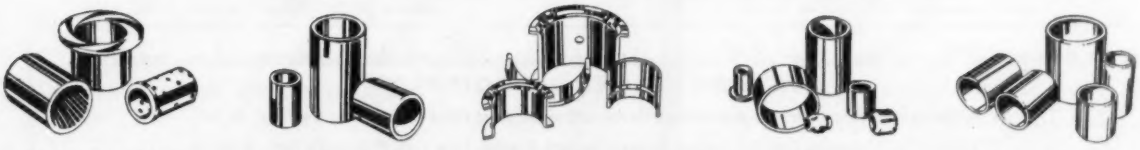

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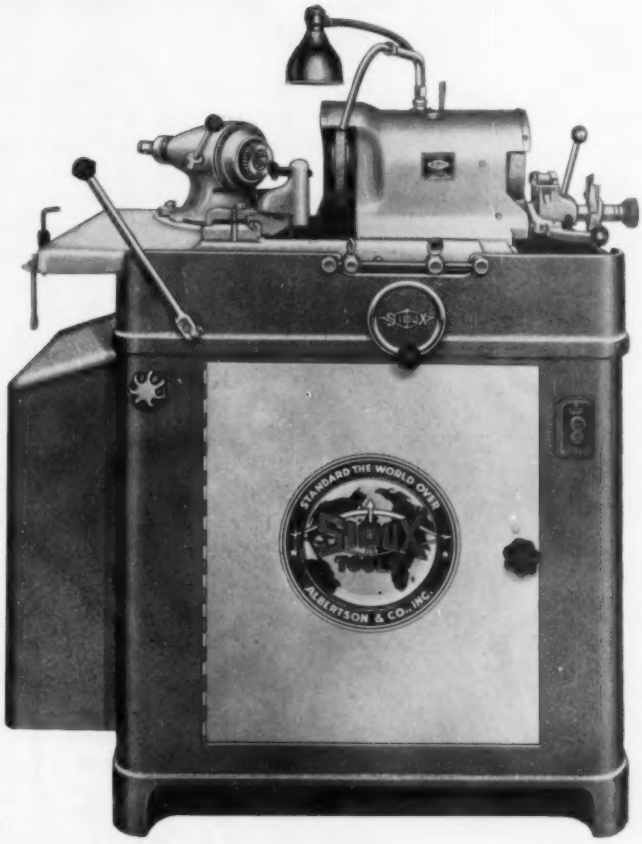

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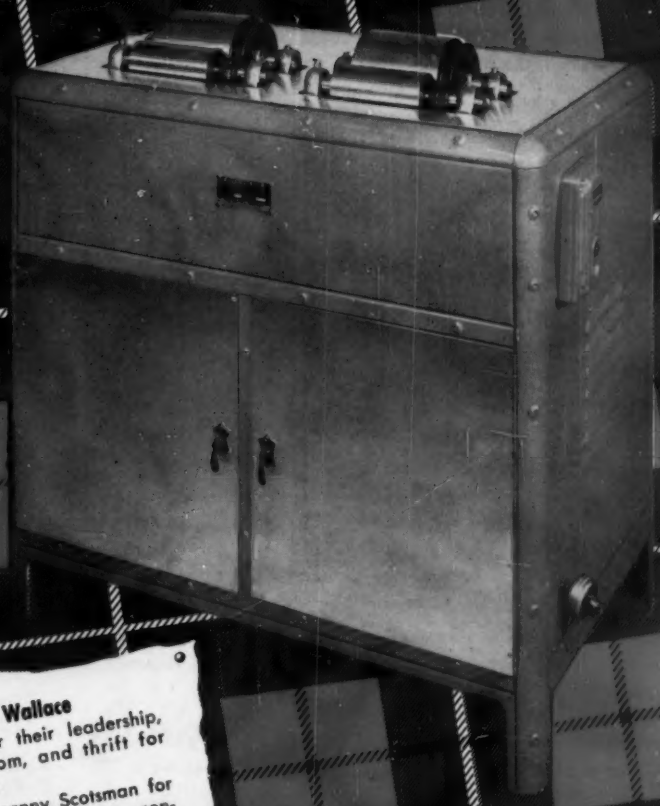

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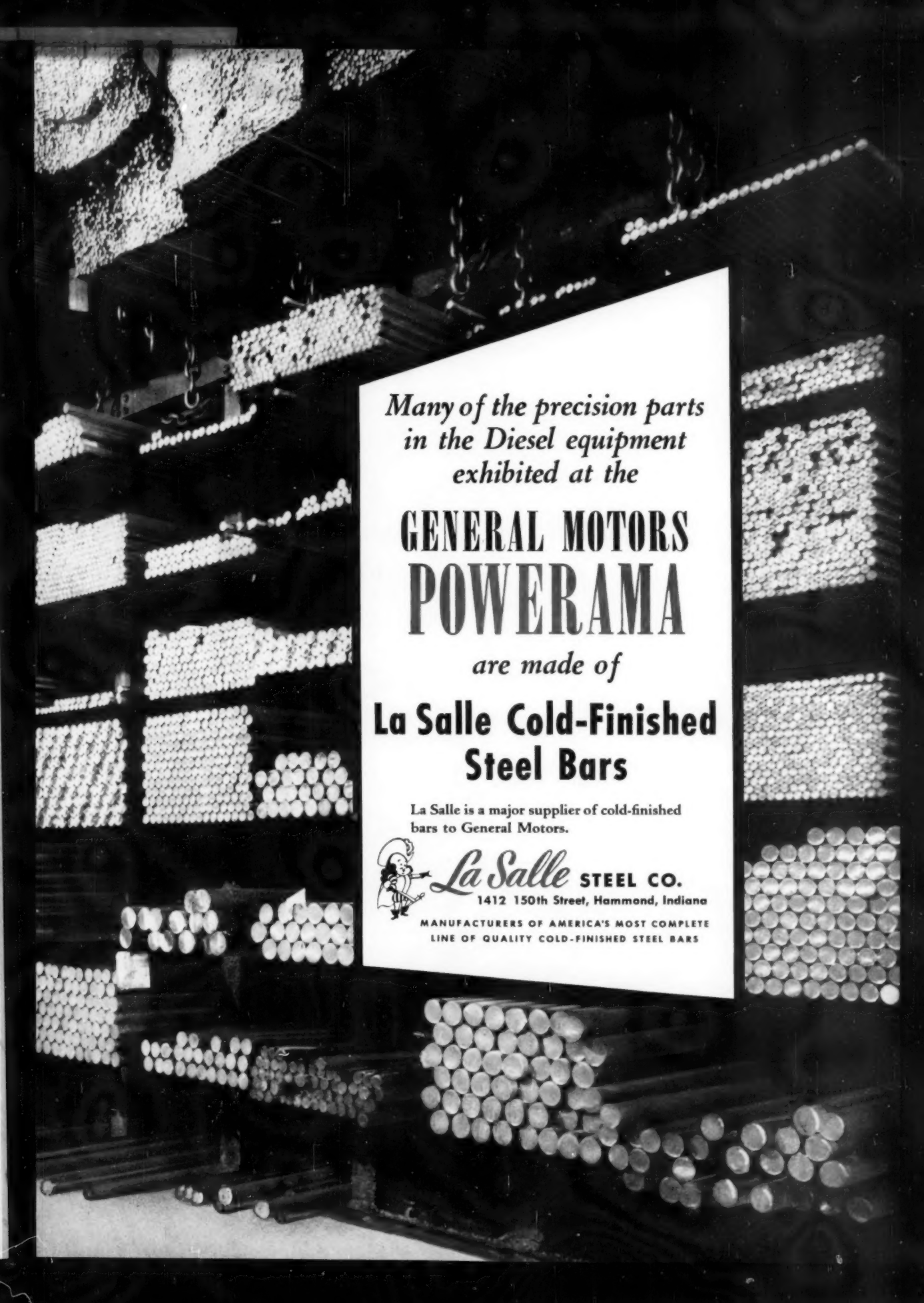
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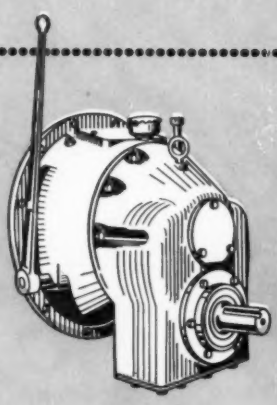

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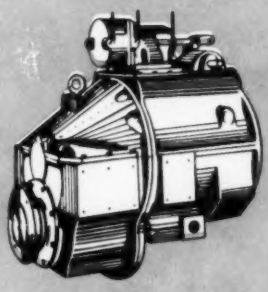

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